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Reporting and derivation of data on financial transactions related to banks' securities holdings

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Abstract

This paper contributes to the ongoing efforts by the European authorities to reduce the reporting burden for banks by assessing the statistical methods currently used to compile data on financial transactions related to securities holdings. Based on statistical information collected from the Banca d'Italia, we compare data on purchases of securities net of sales and redemptions reported by banks with transaction estimates based on indirect (balance sheet) methods that are permitted within the methodological framework of datasets compiled by the European System of Central Banks (ESCB). Although the direct method of collecting data on transactions is more costly for reporting agents, it produces results which are fully aligned with current statistical methodological standards (European System of Accounts 2010, ESA 2010). By contrast, the indirect method is a simplified and less costly approach. The recent development of high-quality data sources such as the ESCB integrated system for the market prices of securities – the Centralised Securities Database – has boosted the attractiveness of indirect methods since they have the potential to deliver accurate and reliable estimates. The significance of the differences between direct collection and indirect compilation of these data is analysed in detail for listed ISIN securities that are actively traded on exchanges, by also considering the impact of price volatility and trading activity. From an aggregated perspective, all indirect methods produce results which are comparable and consistent with the ESA 2010 methodology for all instrument types. There are some minor differences for equity instruments, due to the higher price volatility and trading activity associated with these instruments, but the overall aggregated dynamics are also well captured by indirect methods in these cases. The results thus support implementing simplified reporting solutions that would reduce the burden of statistical data collection without jeopardising statistical quality. It should also be noted that the differences would be expected to be even smaller if the methods are applied at a monthly frequency (as may be the case in future in the context of the ESCB Integrated Reporting Framework, for instance) instead of at a quarterly frequency, as in our exercise.

Keywords: micro data, security-by-security data, securities, transaction data.

JEL codes: C18, C81, G15.

Non-technical summary

The European System of Central Banks (ESCB) is currently fully engaged in lowering the burden of its collection of statistics from banks[1] by developing a standardised and integrated reporting framework based on state-of-the-art compilation methodologies. One of the areas in which efforts are ongoing is the reporting and derivation of data on financial transactions related to banks' securities holdings.

Data on financial transactions represent a fundamental input for assessing macroeconomic development. While the approaches used to collect and compile data on transactions differ widely across countries and datasets, they can generally be grouped into two categories: the direct collection of data on financial transactions from reporting agents, and indirect methods used by statistical compilers to estimate information based on available data. While direct collection obviously measures transactions in a way which is more accurate and in line with statistical methodology (i.e. the requirements of international statistical standards such as the European System of Accounts 2010 (ESA 2010)), such an approach places a burden on reporting agents. Recent improvements to the sources underlying indirect methods now provide additional reasons for reassessing compilation strategies.

This paper contributes to the ongoing discussions by presenting a novel comparison of different available approaches to collecting and compiling transaction data for the securities holdings of deposit-taking corporations, and how this might impact the compilation of macro and micro statistics. Data on financial transactions collected by the Banca d'Italia as part of the national implementation of MFI balance sheet statistics are compared with estimates obtained from indirect methods that are permitted in the methodological framework for datasets compiled by the ESCB. The comparison is performed for listed ISIN[2] securities that are actively traded on exchanges.

The main results are twofold. First, it is shown that indirect methods deliver robust estimates when compared with true transaction data, for the purpose of compiling macroeconomic statistics. This outcome holds even when drilling down at the instrument level and across time. The results of this paper thus support the implementation of simplified reporting solutions that would reduce the burden of statistical data collection on reporting agents, without jeopardising statistical quality. From a micro perspective, however, significant differences may arise when trading activity and/or price volatility is high. Therefore, for the purposes of performing micro analyses, the direct collection of data on financial transactions would seem to provide more precise information. At the same time, such data collection would need to be justified by concrete analytical needs.

1 The terms "deposit-taking corporations" and "banks" are used interchangeably throughout this paper.

2 International Securities Identification Number.

1 Introduction

Traditionally, as new user needs have arisen the ESCB has set out statistical regulations for banks' reporting in silos, allowing national central banks (NCBs) to collect the information required as part of their national statistical (and/or supervisory) reporting frameworks. In practice, this has resulted in extremely costly and heterogenous reporting systems for banks, featuring (among other things) duplications and overlaps in the reporting, complex reporting schedules and processes, and different methodological approaches.

Data on financial transactions are an essential ingredient for assessing macroeconomic developments for monetary, economic and financial stability analysis purposes, but at the moment reporting and compiling them is particularly challenging. The methodological approaches in place vary significantly across euro area countries, statistical domains and instrument types. In some cases, data on transactions are collected directly from reporting agents while in other cases national central banks (NCBs) derive such data indirectly. This indirect approach usually refers to changes in stocks[3] which are adjusted for effects relating to revaluations (due to variations in prices and exchange rates) and changes in volumes (i.e. write-offs in the case of loans, and so-called reclassifications). In turn, data on these effects are either collected from reporting agents or estimated by the NCBs based on information available internally (e.g. exchange rates or market prices for securities) or transmitted by reporting agents on an ad hoc basis.

In the context of the development of the Integrated Reporting Framework (IReF), the ESCB is looking at standardising existing national practices in the euro area for the compilation of transactions and the corresponding reporting requirements. The goal of the IReF programme is, as much as possible, to integrate the ESCB's existing statistical data requirements for banks into a unique and standardised reporting framework that would be directly applicable across the euro area[4]. A qualitative stock-taking survey of the state of play of statistical reporting across domains and countries was conducted in 2018[5] to help design scenarios relating to the various collection aspects (e.g. reporting dates, data frequency, derogations, etc.) of a possible integrated framework. With regard to the compilation of financial transactions related to banks' securities holdings (i.e. purchases of securities net of sales and redemptions), the banking industry and other affected stakeholders supported an indirect approach rather than the direct collection of data on transactions. However, it became clear that any choice of standardised methodology could only be based on a quantitative study that would compare the results of the methods available and, specifically, assess the relevant estimates against the approach favoured under the ESA 2010[6], which lays down the statistical accounting

3 The terms "stocks" and "outstanding amounts" are used interchangeably throughout this document.

4 For further information see the dedicated page on the ECB's website and references therein.

5 See European Central Bank (2019a).

6 Regulation (EU) No 549/2013 of the European Parliament and of the Council of 21 May 2013 on the European system of national and regional accounts in the European Union, (OJ L 174, 26.6.2013, p. 1).

standards to be applied in Europe. In this regard, it is worth noting that the ESCB Centralised Securities Database (CSDB), a reference integrated system of the market prices of securities, has improved its coverage and quality in recent years, thus enhancing the attractiveness of indirect methods and calling for a reassessment of previous national choices made in respect of compilation strategies for financial transactions.

This paper presents a quantitative study based on a granular dataset collected by the Banca d'Italia from resident deposit-taking corporations (i.e. banks) in the context of the national implementation of monetary financial institution (MFI) balance sheet items (BSI) statistics. The dataset covers security-by-security (s-b-s) monthly data on outstanding amounts and transactions according to the ESA 2010 methodology. This granular dataset, complemented by information from the CSDB and from the dataset on Securities Holdings Statistics by Sector (SHSS), is then also used to estimate transactions based on indirect methods which are allowed in the methodological framework of SHSS and BSI statistics[7] and which are currently in use in several euro area countries. As the exercise requires the availability of market data the comparison is limited to listed ISIN securities that are actively traded on exchanges. This paper offers a detailed analysis of the results of the exercise, the main objective being to provide quantitative-based evidence for the choice of methodology that is likely to be adopted by the ESCB under the forthcoming IReF.

The paper is structured as follows. Section 2 introduces the various methods considered for the compilation of financial transactions related to securities holdings. Section 3 details the main features of the s-b-s dataset used in the exercise. Section 4 presents the main results, first at the level of individual securities to investigate the main drivers of the observed differences, and then on an aggregated basis. Section 5 discusses the main lessons learnt, and provides some remarks regarding the estimation of financial transactions related to securities which are either unlisted or not actively traded on exchanges. Section 6 concludes.

7 See European Central Bank (2019b).

2 Methodologies for estimating data on financial transactions

According to ESA 2010, a "*transaction is an economic flow that is an interaction between institutional units by mutual agreement*" (paragraph 1.66). In particular, a "*financial transaction between institutional units is a simultaneous creation or liquidation of a financial asset and the counterpart liability, or a change in ownership of a financial asset, or an assumption of a liability*" (paragraph 5.02).[8] Hence, in respect of securities holdings any purchase of securities, whether at issuance or on the secondary market, as well as any sale or redemption of securities, would be treated as a transaction in statistical terms.[9]

However, current practices regarding the reporting and compilation of financial transactions vary significantly across euro area countries as well as across statistical domains and instrument type.[10] In some cases, data on transactions are collected directly from reporting agents, while in others, NCBs derive transactions indirectly. For securities holdings, the indirect approach involves deriving transactions from changes in stocks which are adjusted for effects which are not related to transactions, namely:

- revaluations, reflecting effects arising from changes in prices and exchange rates;
- other changes in volume, reflecting effects where an aggregated time series shows a break due to, for example, corporate restructuring, the reclassification of counterparties and of assets and liabilities, the correction of reporting errors, or the introduction of new statistical concepts or definitions[11].

Data on these effects are either estimated by the NCBs or the ECB based on information available internally (e.g. currency breakdowns, exchange rates and market prices of securities), or are transmitted by reporting agents as part of the official national collection frameworks or on an ad hoc basis.

This paper considers five different methods that could potentially be adopted by the IReF for the compilation of financial transactions. Interpretations are then provided for each method, together with some explanations as to how they might translate into concrete requirements for reporting agents. The comparison only considers

8 Similar references can be also found in the Handbook on Securities Statistics in paragraphs 5.10 to 5.20.

9 ESA 2010 also stipulates, in paragraph 5.150, how to deal with transactions related to the (de-)listing of equity shares.

10 See Section V of the final report from the ESCB task force on portfolio investment collection systems for a detailed discussion of the data collection systems available to collect such information.

11 Corporate restructuring may refer, for example, to mergers or acquisitions (i.e. take-overs) in which either one of the two corporations involved ceases to exist or the two corporations form an entirely new corporation. Reclassifications of counterparties involve changes in the country of residency or sector classification of an entity. Similarly, reclassifications of assets and liabilities cover modifications regarding the instrument type, maturity or currency of denomination. For additional information on the concept of reclassifications, please see the Manual on MFI balance sheet statistics.

securities denominated in euro. Revaluations due to changes in exchange rates can therefore be ignored, resulting in much easier calculations. However, the results remain robust given the very limited impact of non-euro denominated securities on total securities holdings.[12] In addition, the exercise does not consider the impact of interest accruals on debt securities – in all likelihood, this is extremely limited during the periods under consideration given the low interest rates applicable.[13]

The methods and their interpretations are formalised in Annex 1.

2.1 Method 1: ESA 2010 approach

This method corresponds to the approach favoured in the ESA 2010 and is the benchmark for our comparison exercise. Sales and purchases during the reference period are valued at their transaction values.

The information can be collected from reporting agents either on an aggregated basis or s-b-s, distinguishing between gross purchases and gross sales. However, in all cases, reporting agents should rely on transaction-by-transaction information to compile the data to be reported according to the requirements. Intra-period transactions (i.e. sales of securities purchased during the same reference period) are also considered in the calculations. This approach is equivalent to collecting all gains and losses (realised and unrealised) for holdings during the period and deriving transactions indirectly by adjusting stock changes for such revaluation effects.

Example

Let us suppose a bank holds 1,000 units of equity security A at the end of a year, and that during the first quarter of the next year the following transactions take place for that security: a purchase of ten additional units which are held until the end of the period, a purchase of two units which are sold during the same period, and a sale of five units which were held at the beginning of the period. At the end of the first quarter, the bank will hold 1,005 units of security A. Figure 1 shows the market prices at the beginning and at the end of the period, and at the points in time when the transactions take place. No exchange rate revaluations or other changes in volume apply.

[12] As at December 2019 holdings of debt securities and holdings of equity denominated in currencies other than the euro by Italian deposit-taking corporations amounted to €32 billion and €15 billion respectively, i.e. 5% and 11% respectively of the total holdings of debt securities and equity.

[13] Outstanding amounts of debt securities are affected by interest accruals in the sense that they increase when interest accrues and decrease when interest is paid. The equations in Annex 1 should therefore, in principle, be amended to reflect the impact of accruals by distinguishing between “dirty” and “clean” prices. These effects have not been included in the scope of this paper for the sake of simplicity. See also Section 3.3.

Figure 1

Units of equity security A on the balance sheet, transactions during the period and corresponding market prices

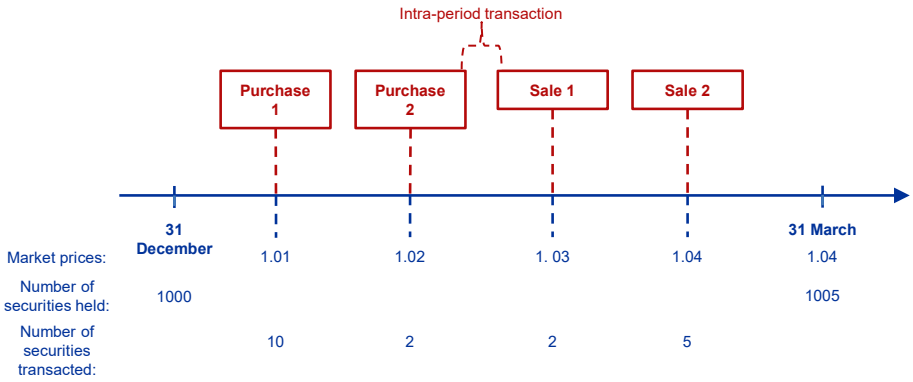

Table 1

Derivation of transactions under Method 1

Number of securities held		31-Dec	1,000
		31-Mar	1,005
Prices (EUR)	**Beginning of the period**	31-Dec	1.00
	Time of Purchase 1		1.01
	Time of Purchase 2		1.02
	Time of Sale 1		1.03
	Time of Sale 2		1.04
	End of the period	31-Mar	1.04
Outstanding amounts		31-Dec	1,000.00
		31-Mar	1,045.20
Number of securities transacted	**Purchase of securities held until end of the period**	Purchase 1	10
	Intra-period transaction	Purchase 2	2
		Sale 1	2
	Sale of securities held at beginning of the period	Sale 2	5
Value of transactions		Purchase 1	10.10
		Purchase 2	2.04
		Sale 1	-2.06
		Sale 2	-5.20
Transactions under Method 1			4.88
Revaluations under Method 1			40.32

As Table 1 shows, the outstanding amount of equity security A increases from 1,000 at the beginning of the quarter to 1,045.2 at the end of the quarter. The difference in stocks is equal to the sum of the total value of the transactions taking place during the period (4.88) and the price revaluations (40.32). It is also easy to verify that, in line with the description of equation 6 in Annex 1, the price revaluations are equal to

the realised gains on the securities sold during the period (5*0.04+2*0.01=0.22) plus the unrealised gains on the securities held and those bought during the period (995*0.04+10*0.03=40.1).

2.2 Method 2: Balance sheet method used in BSI statistics

This approach considers sales and purchases made during the reference period, excluding intra-period transactions, and values them on a s-b-s basis at the relevant market prices on the opening and the closing balance sheets respectively.

This is equivalent to calculating revaluations relating to price changes by only accounting for unrealised holding gains on securities that were held throughout the period. Once again, the information can be collected from reporting agents on either an aggregated basis or s-b-s, but the advantage of the method is that reporting agents do not need to trace individual transactions. For each security, the only information required is the number of securities sold which were held at the beginning of the period, or the number of securities purchased and still held at the end of the period (i.e. excluding intra-period transactions), or the number of securities held throughout the reference period. Aggregates are derived based on market prices at the beginning and at the end of the reference period, rather than on market prices at the time sales and purchases take place.

Example [continued]

Considering that the bank sells five units of equity security A, the number of securities held throughout the period is 995. Based on the information summarised in Table 2, price revaluations under Method 2 can be calculated as the unrealised gains on these securities (39.80). In turn, transactions are calculated as the purchase of ten units valued at the market price on 31 March (1.04) minus the sale of five units valued at the market price on 31 December (1.00), equalling 5.40. Once again, the sum of the estimated transactions and revaluations is equal to the change in outstanding amounts.

Table 2
Derivation of transactions under Method 2

Number of securities held		31-Dec	1,000
		31-Mar	1,005
Prices (EUR)	Beginning of the period	31-Dec	1.00
	End of the period	31-Mar	1.04
Outstanding amounts		31-Dec	1,000.00
		31-Mar	1,045.20
Number of securities transacted	Purchase of securities held until end of the period	Purchase 1	10
	Sale of securities held at beginning of the period	Sale 2	5
Number of securities held throughout the period			995
Transactions under Method 2			5.40
Revaluations under Method 2			39.80

2.3 Method 3: Simplified balance sheet method used in BSI statistics

This approach estimates revaluations for price changes as the (unrealised) holding gains on securities that are held throughout the period, estimating the number of securities held throughout the period as the lower of the number of securities held on the opening and the closing balance sheets.

This represents a simplification of Method 2, in that information on the securities held throughout the period (or, equivalently, sold or purchased excluding intra-period transactions) is estimated rather than obtained from reporting agents. Method 3 can thus be applied by compilers based on s-b-s information on stocks, without any additional information required from reporting agents – i.e. to the extent that the market prices at the beginning and at the end of the period are known to the compilers. Transactions are estimated indirectly by adjusting stock changes for the estimated price revaluation effects.

Example [continued]

Based on the information summarised in Table 3, under Method 3 price revaluations are calculated as the lower of the number of units of equity security A at the beginning and at the end of the quarter (1,000) multiplied by the change in prices, thus equalling 40. Given that the units of equity security A held increased during the quarter, transactions can be calculated based on equation 10 in Annex 1 as the increase in units held of equity security A (5) multiplied by the market price at the end of the period (1.04), equalling 5.2. In turn, the sum of transactions and price revaluations is equal to the change in outstanding amounts.

Table 3

Derivation of transactions under Method 3

Number of securities held		31-Dec	1,000
		31-Mar	1,005
Prices (EUR)	Beginning of the period	31-Dec	1.00
	End of the period	31-Mar	1.04
Outstanding amounts		31-Dec	1,000.00
		31-Mar	1,045.20
Transactions under Method 3			5.20
Revaluations under Method 3			40.00

2.4 Method 4: SHSS approach

The SHSS approach[14] values all sales and purchases made during the reference period at the average of the market prices at the beginning and at the end of the reference period. This is equivalent to considering, on an s-b-s basis, the difference between the number of securities held on the opening and the closing balance sheets and multiplying this figure by the average market price. Compilers can apply also this approach based on s-b-s information on stocks, without needing to obtain any additional information from reporting agents. The price information needed is the same as for Method 3 (i.e. the prices at the beginning and the end of the reference period).

Example [continued]

Using the SHSS methodology, transactions can be calculated from the information summarised in Table 4 as the difference between the number of units of equity security A held at the beginning and at the end of the period (5) multiplied by the average of the market prices at the beginning and at the end of the quarter (1.02), equalling 5.1.

[14] The current SHSS Regulation and Guideline allow several alternatives for the data collection and the reporting by NCBs. The SHSS system calculates the transactions according to the option chosen by the respective NCB. For example, the information on transactions is sometimes that reported by the NCB while at other times it is calculated by the system, with different methods used according to the data available (e.g. stocks available at a monthly or a quarterly frequency). The calculations may therefore differ across countries. Where transactions are calculated by the system and only stocks are reported, revaluations due to changes in prices and exchange rates are calculated based on Method 4. The methodology followed to compile transactions in the SHSS system is detailed in Deutsche Bundesbank (2015), "Securities holding statistics for analysing holdings of securities in Germany and Europe: methodology and results", March, pp. 95-107.

Table 4
Derivation of transactions under Method 4

Number of securities held		31-Dec	1,000
		31-Mar	1,005
Prices (EUR)	Beginning of the period	31-Dec	1.00
	End of the period	31-Mar	1.04
	Average of prices at beginning and end of the period		1.02
Outstanding amounts		31-Dec	1,000.00
		31-Mar	1,045.20
Transactions under Method 4			5.10
Revaluations under Method 4			40.10

Based on equation 13 in Annex 1, price revaluations are calculated as the average number of equity securities held during the period (1,002.5) multiplied by the change in market prices during the period (0.04), equalling 40.1. The sum of transactions and price revaluations is equal to the change in outstanding amounts.

2.5 Method 5: Modified SHSS approach

This method is a modified version of Method 4. It values all sales and purchases during the reference period at the average of the daily market prices during the reference period.

This is equivalent to considering, on an s-b-s basis, the difference between the number of securities held on the opening and the closing balance sheets and multiplying this figure by the average of the daily market prices for the reference period instead of the simple average of the prices at the beginning and at the end of the period (as in Method 4). Also this method is easy for compilers to apply, although it relies on the availability of reliable information on daily prices.

Example [continued]

Based on the information summarised in Table 5, under Method 5 transactions can be calculated as the difference in the number of units of equity security A that are held at the beginning and at the end of the period (5) multiplied by the average of the daily market prices during the quarter (1.03), equalling 5.15. In this case, revaluations can be calculated based on equation 16 in Annex 1 as 40.05. Once again, the sum of transactions and price revaluations is equal to the change in outstanding amounts.

Table 5
Derivation of transactions under Method 5

		31-Dec	1,000
Number of securities held		31-Mar	1,005
Prices (EUR)	Beginning of the period	31-Dec	1.00
	End of the period	31-Mar	1.04
	Average of daily prices		1.03
Outstanding amounts		31-Dec	1,000.00
		31-Mar	1,045.20
Transactions under Method 5			5.15
Revaluations under Method 5			40.05

2.6 Comparing the methods

Table 6 provides a quick review of the main features of the five methods and their implications in terms of reporting requirements. Obviously, the methods produce results which vary according to price volatility, the characteristics of the securities and the structure of the transactions. Although market prices may represent a good approximation of transaction values at a certain point in time, indirect methods use price indicators (e.g. market prices at the beginning and the end of periods, mid-prices or daily averages) that may introduce some noise into the measurement, in particular when there are large market movements. For example, for securities with high price volatility, the values at which purchases and sales take place are likely to differ greatly from the market price indicators used by Methods 2-5 (see also the example provided below). These price indicators may also differ between themselves: the market prices on the opening and the closing balance sheets are different from the average price during the period, so Methods 4 and 5 would be expected to differ from Method 3. Method 5 also tends to differ from Method 4 when the distribution of prices during the period is skewed and, therefore, the average of the daily prices differs from the simple average of the price at the beginning and the price at the end of the period. Similarly, when there is a high turnover (i.e. a high number of transactions during the period) of securities, Method 2 does not include many transactions that would instead be captured under the ESA 2010 approach, and, if the number of securities held at the beginning and at the end of period does vary too much, Method 3 creates significant bias by assuming that the lower of the number of securities held at the beginning and at the end of the reference period represents securities which are held throughout the period.

Table 6

Summary of the methods and implications in terms of reporting requirements

	Transactions	Revaluations	Reporting requirements
Method 1	All sales and purchase valued at transaction value	Realised and unrealised gains	Stocks and transactions
Method 2	Sales and purchases (excluding intra-period transactions) valued at opening and closing market prices for the period	Unrealised gains on securities held throughout the period	Stocks and number of securities held throughout the period
Method 3	Difference in the number of securities multiplied by the market price at the beginning (end) of the period if the number of securities decreases (increases)	Unrealised gains on securities held throughout the period, approximated as the lower of the number of securities held on the opening and the closing balance sheets	Stocks
Method 4	Difference in the number of securities multiplied by the average market price	Unrealised gains on securities held throughout the period, approximated as the lower of the number of securities held on the opening and the closing balance sheets	Stocks
Method 5	Difference in the number of securities multiplied by the average of daily prices	Realised and unrealised gains, calculated by approximating the purchase and sales prices by using the average of daily prices	Stocks

Example [continued]

Let us suppose a bank holds 100 units of equity security B at the end of a year, and that during the first quarter of the next year the following transactions take place for that security: a purchase of three additional units which are held until the end of the period, a purchase of two units which are sold during the same period, and a sale of one unit which had been held at the beginning of the period. At the end of the first quarter, the bank will hold 102 units of equity security B. Figure 2 shows the market prices at the beginning and at the end of the period, and at the points in time when the transactions take place, plus the averages of prices at the beginning and at the end of the quarter, and the average of the daily prices. No exchange rate revaluations or other changes in volume apply.

Equity security B is characterised by a much higher price volatility than equity security A. Using the formulas provided in Annex 1, it is easy to calculate the transactions that apply under the various methods. Table 7 compares the values for the transactions that were calculated for equity securities A and B. The differences are much higher for equity security B, ranging from 8.7% for Method 4 to 52.2% for Method 2.

Figure 2

Units of equity security B on the balance sheet, transactions during the period and corresponding market prices

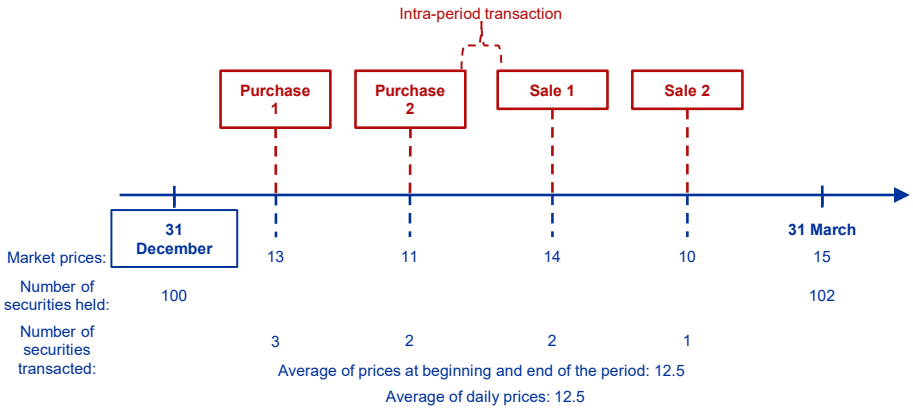

Table 7

Comparing the derivation of transactions for equity securities A and B

		Equity security A	Equity security B
Transactions	Method 1	4.88	23.00
	Method 2	5.40	35.00
	Method 3	5.20	30.00
	Method 4	5.10	25.00
	Method 5	5.15	27.00
Differences from Method 1 (%)	Method 2	10.7%	52.2%
	Method 3	6.6%	30.4%
	Method 4	4.5%	8.7%
	Method 5	5.5%	17.4%

The differences between the methods will be considered further in Section 4, both at the level of individual securities and in the aggregate. Finally, it should be noted that Method 2 will not be considered further in this paper as the data collected from the Banca d'Italia do not allow for the separate identification of intra-period transactions. The method would not, in any case, be very appealing as it would involve tracing some information relating to the transactions executed during the period, resulting in only limited (or no) benefits compared with Method 1.

3 The dataset

The dataset used in the exercise consists of quarterly s-b-s data of ("alive"[15]) euro-denominated listed ISIN securities that are held by Italian deposit-taking corporations and are actively traded on exchanges. For each ISIN, the dataset includes information on outstanding amounts, the numbers of securities held, and gross purchases and sales in each quarter for the period Q4 2017 to Q4 2019.

The dataset was obtained by merging three data sources:

- data collected by the Banca d'Italia from domestic deposit-taking corporations regarding holdings of ISIN and non-ISIN securities, in accordance with the requirements laid down in the "Matrice dei conti" national collection framework (Banca d'Italia, 2008);
- data on outstanding amounts of ISIN securities held by Italian deposit-taking corporations, as available in SHSS;
- daily prices of ISIN securities, as available in the CSDB.

This section first provides some background on the three data sources, before explaining how they are merged into the dataset used in the analyses. The section closes by analysing the resulting dataset and examining how it relates to the original data sources.

3.1 Data from the Banca d'Italia

The Italian collection framework for data from banks includes detailed requirements on securities holdings, the main objective being to provide integrated input data for the compilation of BSI and SHSS statistics. In particular, while BSI statistics are compiled directly using this s-b-s dataset, SHSS statistics are derived using a more complex compilation framework which may result in small differences between the two datasets (see also the SHSS subsection below).

With regard to **ISIN securities**, data are collected on an s-b-s basis for both listed and unlisted securities. Data refer to monthly balance sheet outstanding amounts plus aggregated information on gross purchases and sales during the reference month (i.e. the data are collected at security level and not at transaction level). Outstanding amounts refer to the market (or fair) value of the securities. However, in some cases (e.g. unlisted securities or securities for which no market value is available) reporting agents provide accounting values. The dataset is complemented by the number of equity instruments held underlying the monthly data on outstanding amounts.[16] Gross purchases and sales are valued at transaction value – which will

[15] Securities are considered to be "not alive" when, for example, they have matured, they have been redeemed early, or they have defaulted.

[16] This information is not available for debt securities.

be equal (or close) to the market price when a market price exists (i.e. consistent with Method 1 as described in Section 2.1). The dataset makes it possible to identify holdings of own securities (only outstanding amounts are collected for these securities), which have been excluded from the compilation of BSI statistics since 2017, although they are included in SHSS statistics.

Holdings of non-ISIN securities are normally fairly small, especially in the case of debt securities.[17] Data are collected on an aggregated basis, broken down according to the relevant variables including instrument type, sector and area of residency of the debtor. Positions are valued at accounting value while data on transactions refer to transaction values.

The dataset also covers holdings of debt securities arising from the securitisation of own loans that have not been derecognised from the balance sheet. The data are collected on an s-b-s basis, although they only refer to outstanding amounts. Transactions are estimated as the differences in outstanding amounts corrected for possible reclassification effects. The holdings fall within the scope of both BSI and SHSS statistics.

3.2 Data from SHSS

The SHSS dataset provides s-b-s information on outstanding amounts and transactions involving securities held by institutional sectors in the euro area, broken down by instrument type, sector and area of residency of the debtor, along with further additional classifications.[18] The legal basis for collecting SHSS data is laid down in Regulation ECB/2012/24[19] (and subsequent amendments). This Regulation is complemented by Guideline ECB/2013/7[20] (and subsequent amendments), which also sets out the procedures to be followed by NCBs when reporting to the ECB.[21] Data only cover listed ISIN securities and have been collected on a quarterly basis since Q4 2013.[22]

The integrated input dataset described in the previous subsection represents the basis for the data input into SHSS with regard to Italian deposit-taking corporations. However, the SHSS compilation process uses CSDB reference data in the classification and valuation of the instruments. This could lead to differences between the two datasets. In particular, while SHSS data on outstanding amounts

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17 As at December 2019, non-ISIN debt securities accounted for about 0.5% of the total holdings of debt securities. The figure for equity securities was around 3% for the same reference period.

18 See ECB (2015) for comprehensive information on SHSS and the mechanism for collecting s-b-s information and various examples of the use of SHSS data from both a monetary and a macroprudential perspective.

19 Regulation (EU) No 1011/2012 of the European Central Bank of 17 October 2012 concerning statistics on holdings of securities (ECB/2012/24), (OJ L 305, 1.11.2012, p. 6.).

20 Guideline (EU) 2018/323 of the European Central Bank of 22 February 2018 amending Guideline ECB/2013/7 concerning statistics on holdings of securities (ECB/2018/8) (OJ L 62, 5.3.2018, p. 38).

21 Securities holdings statistics also include a module relating to holdings of banking groups (i.e. SHSG). However, this paper only focuses on the sectoral data module (i.e. SHSS), which is directly comparable with the dataset from the Banca d'Italia.

22 Holdings of non-ISIN securities are also considered in the framework but are reported on a voluntary basis. For this reason, they are not considered in the analysis.

always refer to the market values of securities, as mentioned above the data on outstanding amounts of the dataset from the Banca d'Italia are not based on market values in some cases.[23]

It is also worth mentioning that there are important conceptual and methodological differences between SHSS data and BSI statistics. In addition to the more limited scope for listed ISIN securities, it should be noted that:

- in terms of counterparty sector, while BSI compiles data according to the debtor, SHSS focuses on the issuer of the securities. While in most cases the debtor and issuer of a security coincide, debtors sometimes use the services of a third-party issuer, resulting in differences between the two datasets (e.g. securities issued on a fiduciary basis);
- as mentioned above, while BSI excludes holdings of own securities (i.e. holdings are recorded on a net basis), such holdings are included in SHSS (i.e. holdings are recorded on a gross basis).

While the first point is less relevant for Italian banks, the second point should be borne in mind throughout the remainder of the paper.

3.3 Pricing information from the CSDB

The CSDB is the ESCB's reference database on **ISIN securities**. It contains s-b-s information on all securities issued by EU residents, including securities likely to be held and transacted by EU residents, and securities denominated in euro, whoever the issuer may be and wherever such securities are held. It currently contains around six million "alive" securities.

The database was primarily set up to support the compilation of statistics based on reference information, although it now also supports other non-statistical needs of the ESCB. The dataset covers attributes such as the type of instrument, its market price and the issuer. For instance, these attributes are needed for the classification of the instrument, its valuation according to ESA 2010 principles and the identification of the counterparty for SHSS purposes.[24] The ISIN code represents the common identifier used to link CSDB information with s-b-s datasets such as SHSS. It should also be clarified that the CSDB includes different "price" types that are identified on the basis of their quotation: while the market price normally refers to the so-called "dirty" price, prices may also refer to the "clean" price (i.e. the price of a security net of interest accrued). Dirty prices are used in this paper to reflect the fact

[23] Differences in the classification of the instruments are normally due to errors either in the reporting or in the CSDB and disappear over time during the data revision process.

[24] See European Central Bank (2010) for more information.

that outstanding amounts include interest accruals and the impact of the latter on changes in outstanding amounts is not considered separately in the analyses.[25]

The CSDB is a multisource system containing information received from the different national sources (including reporting agents) available to NCBs, internal ECB sources (e.g. for information on eligible assets[26]), commercial data providers and rating agencies. Data are processed on a daily basis and consist of around two million prices and 400,000 individual record updates.

It should also be noted that commercial data providers are the primary source of the daily market prices included in the CSDB – only limited price information is provided by NCBs. The information is therefore typically only available for ISIN securities listed on organised markets and actively exchanged, although in some cases commercial data providers also provide estimated prices when real market data are not available. The CSDB system has also implemented algorithms which estimate market prices when these are not available from the usual sources, either through cash-flow discounting ("estimated prices") or by setting the market price to 100 ("default prices"), as in the case of zero coupon bonds. In addition, while in principle the CSDB contains daily prices, in practice data quality is typically ensured only for prices at the end of the month, which are currently used in the compilation of statistics (e.g. for valuing outstanding amounts of securities at the end of the month). Hence, the quality of the daily prices, especially when these prices are partly estimated during the month, does have important implications for the analyses performed in this paper, as Method 5 relies on the availability of average daily prices, which may be influenced by inconsistencies between estimated and actual prices.

3.4 Merging the source data

The three data sources were merged by first restricting their scope to listed ISIN securities and adopting a quarterly frequency to reflect the content of SHSS. Only listed ISIN securities common to the Banca d'Italia and SHSS datasets were considered, thereby excluding holdings of own securities[27]. For each quarter and for each ISIN, information from the Banca d'Italia was considered for outstanding amounts, gross purchases and sales. For debt securities, outstanding amounts and CSDB pricing information were used to estimate transactions under Methods 3, 4 and 5, based on the formulas provided in Annex 1. For equity instruments transactions under Methods 3, 4 and 5 were calculated using CSDB pricing information and the number of securities held as reported to the Banca d'Italia. The dataset was further augmented with indicators calculated to take into account the price volatility and turnover (or tradability) of the securities during each quarter.

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25 In detail, in the comparison exercise dirty prices are used to estimate the number of debt securities held on the opening and the closing balance sheets. These numbers are, in turn, used to estimate transactions according to Methods 3, 4 and 5, based on dirty prices. Considering that dirty prices do not diverge significantly from clean prices in the period considered in the analyses, the results are deemed to be robust for the practical approach taken.

26 Further information can be found on the dedicated ECB webpage.

27 As explained above, the dataset from the Banca d'Italia is in fact used as a source for SHSS. Hence, only small differences apply given the specific features of the SHSS compilation framework.

These are defined, respectively, as the coefficient of variation (i.e. the standard deviation divided by the average) of the daily prices, and the sum of purchases and sales divided by the outstanding amounts (which are defined in the calculations as the lower of the outstanding amount at the beginning and that at the end of the quarter).

The following filters are applied to obtain a clean dataset.

1. Investment fund shares/units are excluded owing to the relatively small values observed (i.e. outstanding amounts of €10-12 billion on average during the period) and the low availability of market prices in the CSDB (i.e. investment fund shares/units with available prices in the CSDB account for only about a quarter of the outstanding amounts for the set of ISINs that are part of the merged dataset[28]).

2. Holdings of debt securities arising from the securitisation of own loans that have not been derecognised from the balance sheet are not considered either, as the dataset from the Banca d'Italia does not contain information on transactions based on Method 1.

3. For each quarter, a filter was applied for securities for which no actual prices were available in the CSDB.[29] Given the high coverage of the CSDB, this was equivalent to excluding from the analyses securities that were not actively traded in specific quarters. The filtering was needed to guarantee the availability of pricing information that could be directly used to derive transaction estimates, in accordance with the various methods presented in this paper. Such securities were only excluded for a specific quarter and not for the entire time period so that as many securities as possible can be captured in the comparison.

4. It should be noted that this procedure implies that the pools of securities considered are non-comparable across different quarters. In statistical terms, this has "reclassification effects" on outstanding amounts in the series. While this is not problematic for the purposes of this paper, such effects need to be taken into consideration when analysing how the series evolves over time (see also Section 4.2).

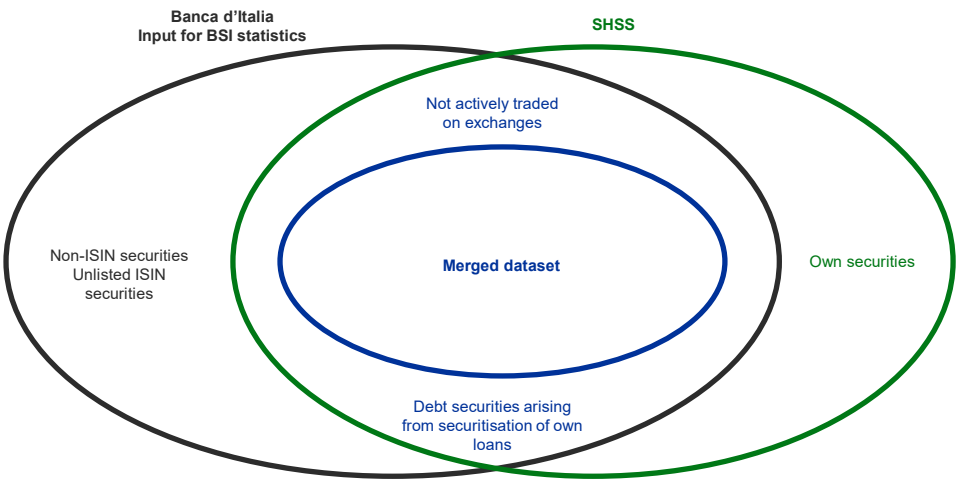
5. A few listed shares and long-term debt securities have also been excluded from the merged dataset for the quarters during which they show data quality issues

[28] As at end-December 2019, CSDB total market capitalisation, in euro, for euro area investment funds covered 100% of market capitalisation as published in the euro area quarterly financial accounts. The CSDB contains market prices for around 140,000 instruments issued by euro area investment funds, meaning that coverage is good (and essentially complete) for such funds. However, the pricing information for non-EU investment funds is suboptimal due to the way investment funds do business: they are often not traded daily, and in most cases they target specific investors, so the main data vendors are not interested in buying the prices for their clients.

[29] CSDB default or estimated prices were not considered, thereby ensuring the high quality of the pricing information to be used in the exercise, especially in terms of the plausibility of using quarterly average prices compared with prices at the beginning and at the end of the period.

in terms of consistency between the data reported on outstanding amounts and transactions or in terms of price dynamics in the CSDB.[30]

Figure 3
Merging the data sources



This section closes by comparing the reference dataset derived from the merging and filtering outlined above, with the SHSS and the BSI official series on securities held by Italian deposit-taking corporations[31]. The differences are explained in detail, with specific reference to the conceptual and methodological aspects.

Chart 1 shows the comparison for the outstanding amounts of short-term debt securities. The merged dataset is quite close to the official BSI series, the difference mostly arising from the filtering on prices (up to €8 billion over the observed period). This component is very volatile over time, reflecting the different underlying pools of securities that remain after the filtering. Holdings of securities that are not denominated in euro, or do not have an ISIN, or are unlisted are not significant, while holdings of own securities and debt securities arising from the securitisation of own loans that are not derecognised from the balance sheet do not affect this category.

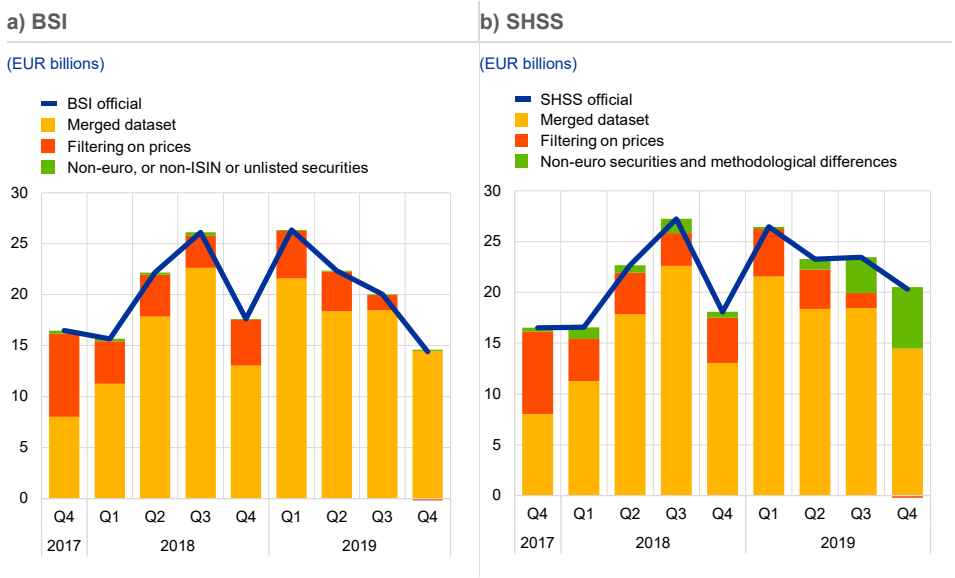
Differences from the SHSS official series are mostly driven by securities holdings not denominated in euro and methodological differences related to the classification and valuation of securities, especially in the most recent quarters.

30 The outstanding amounts of the listed shares and long-term debt securities excluded from the comparison by this filter amount to as much as €3.8 billion and €2.2 billion respectively over the time period. These data quality issues are currently being investigated.

31 As explained above, the BSI series on securities holdings are derived directly from the Banca d'Italia dataset used in this exercise.

Chart 1

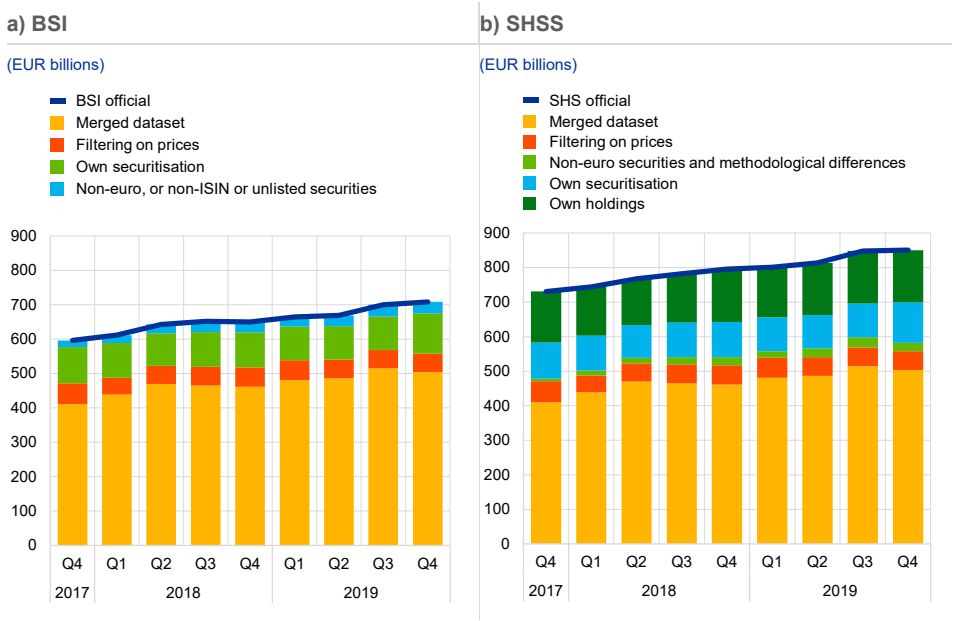
The merged dataset for outstanding amounts of short-term debt securities



Sources: Banca d'Italia (BSI), ECB (SHSS and CSDB) and authors' calculations.
Notes: Holdings of own securities and debt securities arising from the securitisation of own loans that are not derecognised from the balance sheet do not affect short-term debt securities. The category "Filtering on prices" refers to the filtering described in the earlier point 3 and also reflects small differences in valuation between the Banca d'Italia dataset (which relies on data submitted by reporting agents) and the merged dataset (which uses market prices from the SHSS dataset). This results in very minor negative amounts for this category in Q4 2019 (below €0.2 billion). The negative amounts are not reflected in the chart for ease of reference.

Chart 2

The merged dataset for outstanding amounts of long-term debt securities



Sources: Banca d'Italia (BSI), ECB (SHSS and CSDB) and authors' calculations.
Notes: "Own holdings" refers to holdings of own securities, while "Own securitisation" refers to holdings of debt securities arising from the securitisation of own loans that are not derecognised from the balance sheet. The category "Filtering on prices" refers to the filtering described in the earlier point 3, and also reflects the exclusion of ISINs for which data quality issues have been identified, as explained in the earlier point 4.

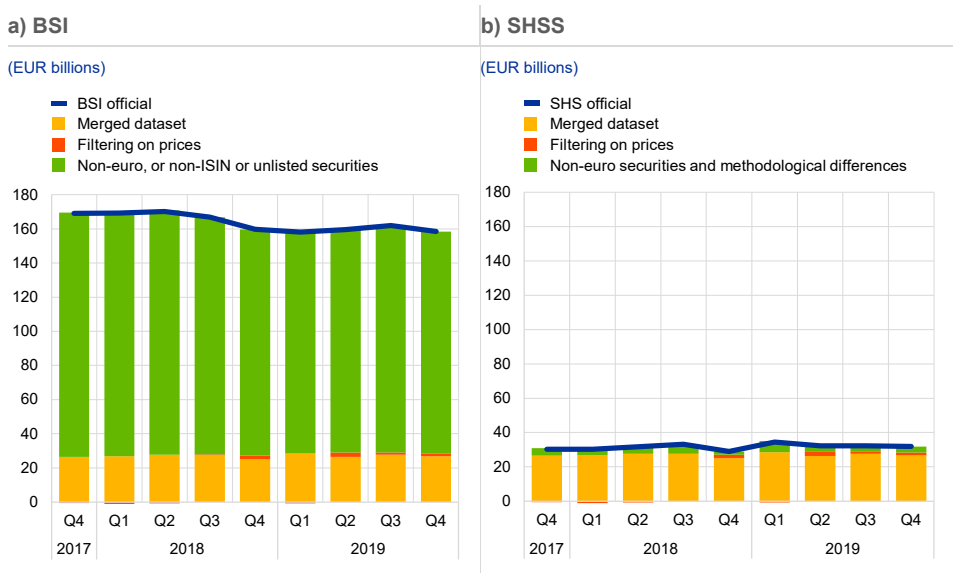
With regard to long-term debt securities, Chart 2 shows the significance of holdings of own securities and debt securities arising from the securitisation of own loans that

are not derecognised from the balance sheet which, in terms of outstanding amounts, account for up to €150 billion and €120 billion over the period respectively. The impact of the price filtering on long-term debt securities is also significant, accounting for amounts ranging between €49 billion and €62 billion over the observed period. Holdings of securities that are not denominated in euro, or do not have an ISIN, or are unlisted explain the residual small differences from the official BSI series, while the residual differences from the official SHSS series (mostly related to methodological differences in terms of classification and valuation of instruments) are also small.

Panel a of Chart 3 reveals that unlisted equity represents most of the equity portfolios of Italian deposit-taking corporations, accounting for between €130 billion and €140 billion of outstanding amounts over the observed period (the amount of non-euro denominated equity instruments included in the BSI series is in fact quite small and accounts for no more than €16 billion over the observed period). In turn, the price filtering has a relatively low impact on equity instruments and accounts for no more than €2 billion over the period, while holdings of own securities as well as residual differences from the official SHSS series (mostly related to methodological differences in terms of the classification and valuation of instruments) amount to between €1.5 billion and €7 billion over the period.

Chart 3

The merged dataset for outstanding amounts of equity



Sources: Banca d'Italia (BSI), ECB (SHSS and CSDB) and authors' calculations.
Notes: Holdings of own securities do not affect equity. The category "Filtering on prices" refers the filtering described in point 3 and also reflects small differences in valuation between the Banca d'Italia dataset (which relies on data submitted by reporting agents) and the merged dataset (which uses market prices from the SHSS dataset). This results in minor negative amounts for this category (below €1.1 billion). The negative amounts are not reflected in the chart for ease of reference.

4 Main results

Based on the dataset described in Section 3, this section provides a detailed analysis of the results of Methods 3, 4 and 5 for compiling transactions compared with the ESA 2010-compliant data collected from reporting agents, which are used as a benchmark. The analysis starts with a comparison for specific securities, the aim being to investigate the sources of possible differences. Aggregated results are then presented to account for the variation of differences over time.

4.1 Comparing the methods for specific securities

Four debt securities and four equity instruments were selected from the dataset, to cover cases with low and high price volatility and low and high turnover respectively. For the sake of simplicity, the comparison was limited to a single quarter (Q2 2018). The tables below summarise all the variables used to estimate transactions, based on Methods 3, 4 and 5. The resulting methods are then compared with the benchmark (i.e. real transaction data as available in the dataset from the Banca d'Italia).

Table 8 presents data for debt securities. Looking at debt security 1, estimated data for transactions under Method 3 are lower than real data for transactions. This is due to the fact that the number of securities on the balance sheet remained relatively stable during the period, while there was a high number of intra-period transactions at a time of (relatively) high price volatility. Method 3 yields a lower value than Methods 4 and 5 as the number of securities held increases while the price at the end of the period (used to estimate transactions under Method 3) is lower than the average prices used under Methods 4 and 5 (see also Annex 1). The average of the daily prices is higher than the average of the prices at the beginning and at the end of the period, resulting in higher estimates under Method 5 than under Method 4. It should also be noted that the transactions estimated under Methods 4 and 5 are also relatively close to the real transactions. Transaction-by-transaction data would be required to further investigate the reasons for this. However, it seems clear that the closeness of the estimates is not due to any intrinsic methodological advantage of the methods but rather to the specific price dynamics of the security during the period (e.g. intra-period transactions taking place at transaction values that, on average, may be close to the averages used in Methods 4 and 5).

Table 8

Comparisons of transactions for selected debt securities

		Debt security 1 High volatility High turnover	Debt security 2 High volatility Low turnover	Debt security 3 Low volatility High turnover	Debt security 4 Low volatility Low turnover
Price volatility		0.0218	0.0115	0.0039	0.0010
Turnover		15.35	0.17	1,689.60	0.17
Number of securities held	T_0	14,000	41,208	1	23,118
	T_1	14,491	48,457	1	23,089
Prices (EUR)	T_0	94.5	101.1	99.9	100.3
	T_1	88.6	98.6	100.8	100.2
	Average of prices at T_0 and T_1	91.5	99.8	100.3	100.3
	Average of daily prices	92.9	100.2	100.0	100.4
Outstanding amounts (EUR)	T_0	1,322,403	4,166,523	55	2,319,768
	T_1	1,284,062	4,775,472	55	2,312,892
Method 1	Transactions (EUR)	45,148	608,677	-10	-40
	Purchases (EUR)	10,168,934	703,275	46,459	200,818
	Sales (EUR)	10,123,786	94,598	46,469	200,858
Method 3 - Transactions (EUR)		43,557	714,441	-0	-2,951
Method 4 - Transactions (EUR)		44,994	723,720	-0	-2,948
Method 5 - Transactions (EUR)		45,676	726,518	-0	-2,952

Source: Banca d'Italia (BSI), ECB (SHSS and CSDB) and authors' calculations.
Notes: Data refer to Q2 2018. T_0 and T_1 refer to the beginning and the end of the quarter respectively. Outstanding amounts and transactions are expressed in euro. In particular, outstanding amounts are sourced from the Banca d'Italia, while the number of securities is estimated as outstanding amounts divided by prices. Prices are sourced from the CSDB. Real data on transactions are sourced from the Banca d'Italia. Price volatility is derived as the coefficient of variation of the daily prices within the quarter, while turnover represents the sum of purchases and sales during the quarter divided by the outstanding amounts (which are defined in the calculations as the lower of the outstanding amount at the beginning and at the end of the quarter). Debt securities 1 and 2 are allocated to a "high volatility" group as they belong to the 20% upper tail of the distribution of the debt securities in respect of this indicator.

For debt security 2, even if the values for sales and purchases point to a relatively low level of intra-period transactions, price volatility seems to play a fairly important role. In particular, the value for purchases is lower than the estimates under Methods 3, 4 and 5, hinting at the possibility that these purchases took place at a price which was lower than both the price at the end of the period and the average price. In addition, as for debt security 1, the estimate of transactions under Method 3 is lower than it is under Methods 4 and 5 as the number of securities held increases while the price at the end of the period is lower than the average price. For debt security 3, the same number of securities are held on the balance sheet at the beginning and at the end of the period, so transactions estimated under Methods 3, 4 and 5 equal zero. However, as the numbers of securities bought and sold during the period were similar and the price volatility was low, there were only small differences from the real transaction data, even in the presence of high turnover. For debt security 4, the number of securities held on the balance sheet at the beginning and at the end of the period remains virtually unchanged, with the result that estimates for transactions are similar under Methods 3, 4 and 5. In this case the security also has a low price volatility, although the intra-period transactions in a situation in which prices are

decreasing lead, in relative terms, to some small differences from the data for real transactions.

Turning to equity (see Table 9), instrument 1 is characterised by a high number of intra-period transactions, which explain the differences between Method 1 and Methods 3, 4 and 5. Method 3 yields a lower value than Methods 4 and 5 as the number of securities held decreases while the price at the beginning of the period (used to estimate transactions under Method 3) is higher than the average prices used under Methods 4 and 5. The average of the daily prices is higher than the average of the prices at the beginning and at the end of the period, resulting in lower estimates under Method 5 than under Method 4.

For equity instrument 2, Methods 3 and 5 yield very similar values as the price at the beginning of the period is very close to the average price. Real transactions are lower than those estimated under Methods 3 and 5 as some of the sales are likely to take place at prices higher than those for purchases given the price dynamics (i.e. sales may have been concentrated at the end of the period). Method 4 therefore seems to yield values that are closer to those for real transactions because in this specific instance the average price is closer to the end price. For equity instrument 3 there is an increase in the number of securities on the balance sheet and a final price that is much higher than the average price. This is why Method 3 yields a higher value than Methods 4 and 5. The high number of intra-period transactions, even with low price volatility, explains the much higher values for real transactions compared with values estimated by Methods 3, 4 and 5. With low price volatility and low turnover, however, Methods 3, 4 and 5 yield similar results to real transactions, as shown in the case of equity instrument 4.

Table 9

Comparisons of transactions for selected equity instruments

		Equity 1 High volatility High turnover	Equity 2 High volatility Low turnover	Equity 3 Low volatility High turnover	Equity 4 Low volatility Low turnover
Price volatility		0.1124	0.1026	0.0184	0.0121
Turnover		8.88	0.28	7.40	0.02
Number of securities held	T_0	612,377	1,450,985	245,855	20,077
	T_1	478,422	1,383,915	379,143	20,043
Prices (EUR)	T_0	17.4	0.8	65.3	22.7
	T_1	13.3	1.0	68.7	22.9
	Average of prices at T_0 and T_1	15.4	0.9	67.0	22.8
	Average of daily prices	15.7	0.8	66.3	23.3
Outstanding amounts (EUR)	T_0	10,682,913	1,175,298	16,061,707	455,748
	T_1	6,341,488	1,328,558	26,028,167	458,985
Method 1	Transactions (EUR)	-2,539,003	-61,845	10,288,415	-872
	Purchases (EUR)	46,185,002	152,204	101,463,465	4,218
	Sales (EUR)	48,724,005	214,049	91,175,050	5,090
Method 3 - Transactions (EUR)		-2,336,835	-54,327	9,150,221	-772
Method 4 - Transactions (EUR)		-2,056,201	-59,357	8,928,963	-775
Method 5 - Transactions (EUR)		-2,105,999	-54,868	8,839,799	-791

Source: Banca d'Italia (BSI), ECB (SHSS and CSDB) and authors' calculations.
Notes: Data refer to Q2 2018. T_0 and T_1 refer to the beginning and the end of the quarter respectively. Outstanding amounts and transactions are expressed in euro. In particular, the number of securities is sourced from the Banca d'Italia, while outstanding amounts are calculated by multiplying the number of securities by prices. Prices are sourced from the CSDB. Real data on transactions are sourced from the Banca d'Italia. Price volatility is derived as the coefficient of variation of the daily prices within the quarter, while the turnover represents the sum of purchases and sales during the quarter divided by the outstanding amounts (which are defined in the calculations as the lower of the outstanding amount at the beginning and at the end of the quarter).

Overall, the results discussed so far confirm the fact that intra-period transactions are driving the differences between real transactions and Methods 3, 4 and 5: the more intra-period transactions there are, the more likely it is that real transactions are not captured correctly by any estimation method. In addition, the higher the price volatility, the higher the differences between Methods 3, 4 and 5. Methods 4 and 5 tend to smooth the estimates compared with Method 3 as they use average prices. This does not, however, imply better results, as the differences are driven by price dynamics: the closer the transaction prices are to the average prices, the better the estimates are under Methods 4 and 5. In practice, though, transactions can be concentrated at the beginning or at the end of the period, resulting in better estimates under Method 3 in such cases.

It should also be noted that if the exercise had been conducted at a monthly frequency the comparisons may have produced much closer results across the methods. In fact, fewer transactions would have been reversed in the same month and, similarly, price volatility over a month would be lower than during a full quarter.

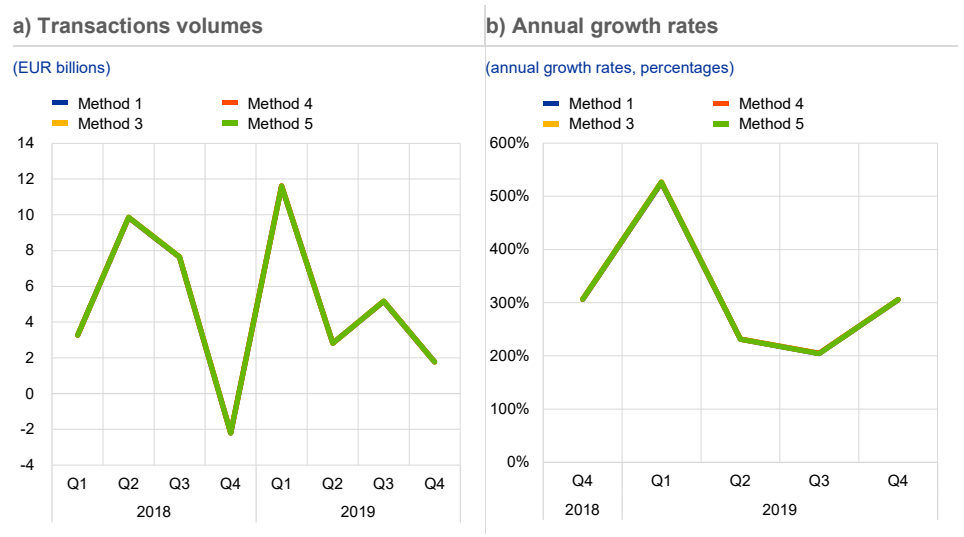
4.2 Aggregated comparisons by instrument type

This section extends the comparison to the overall security portfolios covered in the exercise. It compares the transaction volumes resulting from Methods 3, 4 and 5 and the corresponding annual growth rates (which represent the standard measure used to analyse developments in macroeconomic series) with the benchmark. The charts below present the results for debt securities (short and long-term) and equity instruments, and are complemented by Table 10, which also presents the quarterly and annual growth rates.

As shown in Chart 4, the four methods are essentially equivalent for short-term debt securities. In particular, the largest difference in transaction volumes is €0.02 billion, while the largest difference in annual growth rates amounts to 147 basis points, albeit at a point in time when the growth rate is above 500%. This is due to the fact that short-term debt securities have, on average, very low price volatility, resulting in non-significant differences across the methods, even when intra-period transactions are significant.

Chart 4

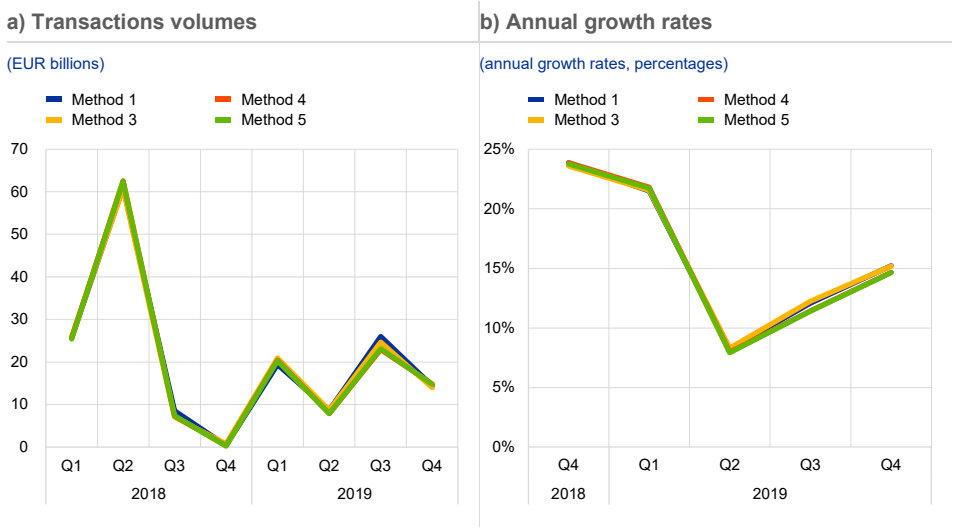
Short-term debt securities



Sources: Banca d'Italia (BSI), ECB (SHSS and CSDB) and authors' calculations.
Notes: Growth rates are computed in accordance with the BSI methodology (see also the manual on MFI balance sheet statistics). In particular, to take into account the different composition of the pool of securities over the quarters, growth rates are calculated by comparing the transactions of a specific period with the outstanding amounts for the corresponding pool of securities at the beginning of the period.

Chart 5

Long-term debt securities

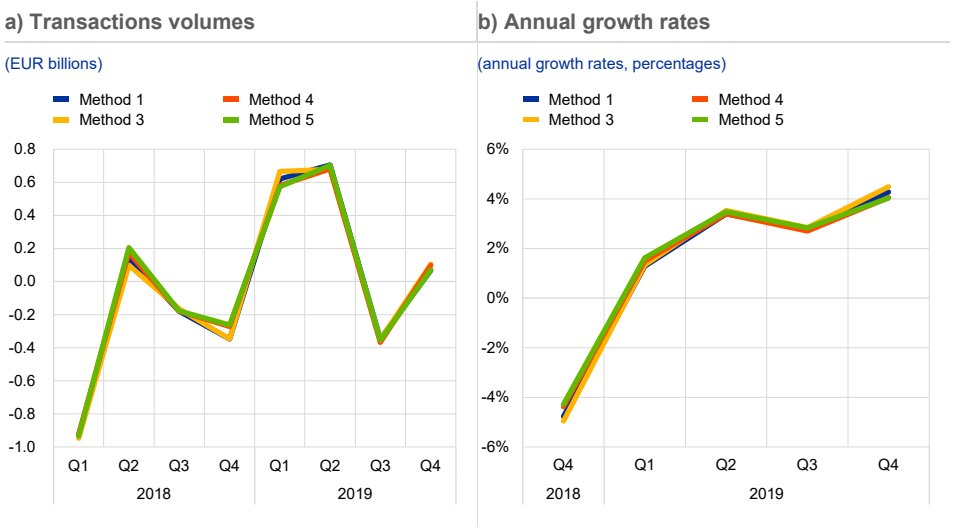


Sources: Banca d'Italia (BSI), ECB (SHSS and CSDB) and authors' calculations.
Notes: Growth rates are computed in accordance with the BSI methodology (see also the manual on MFI balance sheet statistics). In particular, to take into account the different composition of the pool of securities over the quarters, growth rates are calculated by comparing the transactions of a specific period with the outstanding amounts for the corresponding pool of securities at the beginning of the period.

Also for long-term debt securities, the four methods yield very similar results. As shown in Chart 5, Method 3 is slightly closer to the actual transactions, with differences that never exceed €1.51 billion (or 24 basis points in terms of annual growth rates). The differences between Methods 4 and 5 and the actual transactions are somewhat larger, peaking at €3.11 billion in Q3 2019 (or 65 basis points in Q4 2019 in terms of annual growth rates) and at €2.91 billion in Q3 2019 (or 67 basis points in Q4 2019 in terms of annual growth rates) respectively.

Chart 6 shows that the four approaches also result in similar estimates for equity instruments, although there are some small differences. The results seem to be in line with the findings of Section 4.1, as equity instruments are normally more frequently traded than debt securities (i.e. there are more intra-period transactions) and equity prices are typically much more volatile than debt security prices. For instance, price volatility seems to play a role in the differences for Q4 2018, which is characterised by a higher price volatility than the other quarters based on the indicator used in our analyses (see Table 10). At the same time, Method 3 seems to perform similarly to Methods 4 and 5. In Method 3, differences from the actual transactions in absolute terms are always lower than €0.05 billion (or 18 basis points in terms of annual growth rates). Method 4 shows differences peaking at €0.08 billion in absolute terms (or 39 basis points in terms of annual growth rates), while Method 5 delivers a difference of up to €0.08 billion (or 49 basis points in terms of annual growth rates). These findings also seem to relate to the fact that the estimates obtained under Methods 4 and 5 are more sensitive to price volatility.

Chart 6
Equity



Sources: Banca d'Italia (BSI), ECB (SHSS and CSDB) and authors' calculations.
Notes: Growth rates are computed in accordance with the BSI methodology (see also the manual on MFI balance sheet statistics). In particular, to take into account the different composition of the pool of securities over the quarters, growth rates are calculated by comparing the transactions of a specific period with the outstanding amounts for the corresponding pool of securities at the beginning of the period.

Table 10 provides a complete overview of the transaction volumes for the different methods, with the corresponding quarterly and annual growth rates.

Overall, it may be concluded that the differences for specific securities tend to balance out in the aggregate, even in periods of relatively high price volatility such as Q4 2018. As shown in Annex 2, the deviations shown by all indirect methods from the ESA 2010 approach have a very low correlation with price volatility and would appear to be acceptable in the aggregate, given the cost of directly reporting data on transactions and the fact that from an aggregate perspective the "story told by the data" does not change.[32]

[32] The derivation of concrete measures to ascertain what level of deviation is acceptable is considered to be outside the scope of this paper. However, it should be clarified that such a quantification could only be performed in the context of specific econometric modelling frameworks and may therefore depend on the other variables considered in the analyses and their interaction, which might also vary from period to period. Measures of acceptable deviation may therefore lack generality.

Table 10

Comparing transactions according to the different compilation methods

Short-term debt securities

Reference period	Outstanding amounts (EUR billions)		Price volatility (median)	Transactions (EUR billions)				Quarterly growth rate (percentages)				Annual growth rate (percentages)			
	T0	T1		Method 1	Method 3	Method 4	Method 5	Method 1	Method 3	Method 4	Method 5	Method 1	Method 3	Method 4	Method 5
Q1 2018	8.0	11.3	0.0003	3.27	3.27	3.27	3.27	40.86%	40.83%	40.84%	40.83%	-	-	-	-
Q2 2018	8.0	17.9	0.0005	9.85	9.86	9.86	9.86	123.09%	123.28%	123.29%	123.29%	-	-	-	-
Q3 2018	15.0	22.6	0.0006	7.64	7.64	7.65	7.65	51.02%	51.05%	51.06%	51.07%	-	-	-	-
Q4 2018	15.2	13.0	0.0006	-2.20	-2.19	-2.20	-2.20	-14.45%	-14.40%	-14.43%	-14.45%	306.01%	306.60%	306.50%	306.39%
Q1 2019	9.9	21.6	0.0006	11.61	11.63	11.62	11.61	117.03%	117.18%	117.10%	117.06%	525.56%	527.03%	526.59%	526.35%
Q2 2019	15.6	18.4	0.0003	2.81	2.82	2.81	2.81	18.08%	18.10%	18.09%	18.09%	231.11%	231.66%	231.38%	231.26%
Q3 2019	13.3	18.5	0.0003	5.16	5.17	5.17	5.17	38.86%	38.93%	38.95%	38.92%	204.44%	205.05%	204.82%	204.64%
Q4 2019	12.7	14.5	0.0003	1.77	1.77	1.77	1.77	13.93%	13.90%	13.91%	13.91%	305.41%	305.88%	305.78%	305.62%

Long-term debt securities

Reference period	Outstanding amounts (EUR billions)		Price volatility (median)	Transactions (EUR billions)				Quarterly growth rate (percentages)				Annual growth rate (percentages)			
	T0	T1		Method 1	Method 3	Method 4	Method 5	Method 1	Method 3	Method 4	Method 5	Method 1	Method 3	Method 4	Method 5
Q1 2018	410.2	438.5	0.0032	25.67	25.99	25.52	25.38	6.26%	6.34%	6.22%	6.19%	-	-	-	-
Q2 2018	425.0	470.1	0.0042	61.06	60.77	62.58	62.45	14.37%	14.30%	14.72%	14.69%	-	-	-	-
Q3 2018	463.3	464.9	0.0033	8.50	7.08	7.29	7.32	1.84%	1.53%	1.57%	1.58%	-	-	-	-
Q4 2018	454.7	461.7	0.0038	0.36	0.78	0.34	0.25	0.08%	0.17%	0.07%	0.06%	23.85%	23.61%	23.87%	23.78%
Q1 2019	457.1	480.8	0.0049	19.41	20.92	20.42	20.26	4.25%	4.58%	4.47%	4.43%	21.51%	21.56%	21.83%	21.74%
Q2 2019	471.3	486.3	0.0037	8.67	8.69	7.87	7.85	1.84%	1.84%	1.67%	1.66%	8.20%	8.32%	7.96%	7.91%
Q3 2019	473.7	514.9	0.0041	26.01	24.65	22.90	23.10	5.49%	5.20%	4.84%	4.88%	12.08%	12.24%	11.43%	11.41%
Q4 2019	497.9	503.8	0.0034	14.37	13.98	14.83	14.76	2.89%	2.81%	2.98%	2.96%	15.23%	15.19%	14.66%	14.65%

Equity															
Reference period	Outstanding amounts (EUR billions)		Price volatility (median)	Transactions (EUR billions)				Quarterly growth rate (percentages)				Annual growth rate (percentages)			
	T0	T1		Method 1	Method 3	Method 4	Method 5	Method 1	Method 3	Method 4	Method 5	Method 1	Method 3	Method 4	Method 5
Q1 2018	26.5	26.9	0.0454	-0.93	-0.95	-0.92	-0.93	-3.50%	-3.57%	-3.47%	-3.52%	-	-	-	-
Q2 2018	26.8	27.7	0.0443	0.14	0.10	0.18	0.21	0.53%	0.36%	0.65%	0.77%	-	-	-	-
Q3 2018	27.0	27.6	0.0368	-0.18	-0.16	-0.18	-0.18	-0.66%	-0.61%	-0.66%	-0.65%	-	-	-	-
Q4 2018	29.2	25.1	0.0558	-0.35	-0.35	-0.27	-0.26	-1.19%	-1.19%	-0.93%	-0.90%	-4.77%	-4.95%	-4.38%	-4.28%
Q1 2019	23.6	28.5	0.0460	0.62	0.66	0.58	0.57	2.63%	2.81%	2.46%	2.42%	1.28%	1.34%	1.49%	1.62%
Q2 2019	26.8	26.4	0.0458	0.71	0.68	0.68	0.70	2.64%	2.53%	2.54%	2.62%	3.40%	3.53%	3.40%	3.49%
Q3 2019	27.6	27.7	0.0438	-0.35	-0.35	-0.37	-0.35	-1.26%	-1.27%	-1.33%	-1.28%	2.78%	2.84%	2.70%	2.83%
Q4 2019	26.6	26.8	0.0420	0.07	0.10	0.10	0.07	0.25%	0.39%	0.37%	0.26%	4.27%	4.49%	4.05%	4.03%

Sources: Banca d'Italia (BSI), ECB (SHSS and CSDB) and authors' calculations.
Notes: Outstanding amounts and transactions are expressed in billions of euro. Price volatility is derived as the coefficient of variation of the daily prices within the quarter; the median within the quarter across securities is shown in the table. Growth rates are computed in accordance with the BSI methodology (see also the manual on MFI balance sheet statistics). In particular, to take into account the different composition of the pool of securities over the quarters, growth rates are calculated by comparing the transactions of a specific period with the outstanding amounts for the corresponding pool of securities at the beginning of the period.

5 Lessons learnt from the comparison exercise

Section 4 shows that for listed ISIN securities that are actively traded on exchanges (for which there is good coverage of pricing information in the CSDB) both the simplified BSI approach (i.e. Method 3) and the SHSS approach deliver accurate estimates of transaction data. As differences are very small it would be difficult to justify the collection of granular transaction data on methodological grounds.

Apart from this empirical evidence, the design and implementation of the comparison exercise has raised various points which are crucial to bear in mind when developing a successful strategy for compiling aggregated statistics on securities holdings, based on granular data. These considerations are therefore key for ESCB compilers to consider when defining an approach for collecting data from banks in the context of the IReF.

A general point is that compiling balance sheet statistics in a manner which is consistent with the principles of ESA 2010 means that securities holdings must be valued at market (or fair) value.[33] However, this information may not be readily available in banks' internal systems for all types of securities. For instance, securities that are not classified in trading portfolios for accounting purposes are not typically marked to market. Collecting information from reporting agents on the nominal amounts of debt securities held or the number of equity securities held (as is currently the case in many euro area countries in an SHSS context) would therefore represent a good basis for compilers to estimate market values based on CSDB pricing information.

At the same time, the CSDB only focuses on listed ISIN securities and, although it has very high coverage (close to 100% for securities held by euro area residents), thus guaranteeing the availability of reference data for compilation purposes, the availability of pricing information can vary from country to country and according to the type of security. This is because it depends strongly on the commercial sources available and the liquidity of securities, especially for securities issued outside the EU. For instance, in this paper no comparisons can be drawn for investment fund shares/units, and several debt securities had to be filtered out of the exercise, as explained in Section 3.4. Given the ESCB's wide range of needs when it comes to instruments to be covered for compilation purposes, it is becoming more difficult to ensure that all the price data required are available in the CSDB in a timely manner. This is especially apposite for specific markets or securities that are not very liquid or

[33] It should be underlined that such an approach reduces the linkages with banks' internal accounting data, and with data that banks may publish or report to other authorities. In addition, the basic accounting principle stipulating that assets should balance liabilities is no longer applicable in this context. The balancing of the balance sheet is normally achieved by allocating a balancing item to remaining assets or liabilities, something statistical compilers may find challenging to monitor over time. For instance, when a bank writes-down the holdings of a security, in accounting terms this determines a decrease in the outstanding amounts of the security, which is balanced by a loss in terms of capital and reserves. Valuing the holdings at market value means that the loss will normally be matched by a revaluation of the balancing item.

which target particular investors. It implies that getting prices from commercial sources is more challenging in such cases as data vendors normally focus their efforts on the instruments that are most relevant for their clients. Hence, for listed securities that are not actively traded (and even more so for securities that are not listed on organised markets) pricing data can only be collected from reporting agents on a best-effort basis (e.g. based on fair valuation or by simply collecting accounting values)[34]. An alternative would be to estimate the missing prices based on other available data (e.g. cash-flow information or prices of similar securities)[35], although the accuracy of the resulting estimates would again depend on data availability. Default methodologies can also be used.[36]

These points also have important implications for the derivation of transactions. For the simplified BSI and SHSS methods to deliver good estimates of transactions the data collected from reporting agents should make it possible to accurately estimate the number of securities held on the balance sheet. Hence, independently of the approach used to value the outstanding amounts on the statistical balance sheet, the reporting framework must guarantee the collection or the indirect estimation of these data (e.g. based on the nominal amounts of debt securities held when the securities are covered by the CSDB). In addition, good pricing information must be available in the CSDB for listed ISIN securities. In this respect, it should be noted that the simplified BSI and SHSS methods (Methods 3 and 4) seem to be more reliable than the modified SHSS method (Method 5). In fact, while the former only require good pricing information at each period end, the latter uses average prices over the reference period – these can be negatively influenced by outliers[37]. Methods 3 and 4 are very similar, as they only differ according to the price used to estimate transactions – the price at the beginning or at the end of the period under Method 3, or the average of the two under Method 4. From a conceptual perspective neither of the two methods is superior, as their performance is directly dependent on the price at which transactions take place. The empirical exercise showed that under Method 3 the differences from the real transactions were slightly smaller, and were mostly driven by the differences observed for long-term debt securities in Q3 2019.

For securities without pricing information in the CSDB, the derivation of estimates of transactions is strictly related to the approach followed for the valuation of data on outstanding amounts. For instance, if the outstanding amounts of unlisted securities are marked at the accounting values on the statistical balance sheet, an indirect approach for transactions might be preferred (e.g. using the values that are implicitly reported for the valuation of the outstanding amounts).

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34 This approach would enable compilers to close the gap between the merged dataset in Charts 1-3 and the official series. Non-ISIN equity instruments, own securities and debt securities arising from the securitisation of own loans that are not derecognised from the balance sheet would either be covered by the CSDB, or the relevant data would be collected from reporting agents.

35 This approach is followed, for example, for investments funds, for which benchmarks can be used to estimate prices for those funds for which prices are not available. This is done based on the investment strategy or geographical allocations of the funds' investments.

36 It should be noted that the CSDB already offers both options, ensuring that there is at least one price for each security, and providing an automatic alternative in the compilation process.

37 In the CSDB, outliers often materialise given that the compounding algorithm sources pricing information from different sources or markets.

Whichever approach is established, it will also be essential to fix precise and appropriate reporting and compilation rules for securities that may change type. Examples of this would be a listed share which has become unlisted, or a listed security for which no price information is available in the CSDB for a specific period (for which its identification would not be known prior to the collection, as this can change over time). Even if these changes would usually have a limited quantitative impact on outstanding amounts in aggregate terms, the impact on transactions could be quite sizeable.

6 Conclusions

This paper presents empirical findings with regard to the differences between indirect statistical approaches used to derive data on financial transactions (which are related to deposit-taking corporations' holdings of listed ISIN securities that are actively traded on exchanges) and the direct collection of data on transactions (which would be compliant with statistical methodology). Using s-b-s data collected by the Banca d'Italia directly from reporting agents on both outstanding amounts and transactions, it has been possible to compare transaction data compliant with the ESA 2010 approach with estimates based on balance sheet methods used in relation to BSI and SHSS statistics.

The empirical results show that, for listed ISIN securities for which there is good coverage of pricing information in the CSDB, both the BSI and the SHSS approaches deliver accurate estimates of data on transactions in aggregate terms.[38] Although the paper focuses on data over a two-year period, the results seem robust given that that the differences also remain low in periods of relatively high price volatility. The differences are also very small when the results are analysed by instrument type (i.e. debt securities and equity securities). While there seems to be no theoretical reason why one indirect method might be superior to another, the BSI method seems to perform slightly better for this sample over the period considered. In addition, the modified SHS method, which uses the average of the daily prices during the period, relies on good underlying daily data being available in the CSDB. This would seem to make the method more prone to possible errors than the other methods, which only rely on pricing information at the end of each period.

While the ongoing cost-benefit assessment of the IReF will make it possible to evaluate the reporting burden of the direct collection of data on transactions, the empirical exercise performed in this paper shows that this type of data collection does not appear to be necessary for the purposes of compiling accurate macro statistics. This will need to be taken into account when weighing up the benefits of this type of data collection against the burden it would imply for reporting agents.

At the same time, it should be noted that unlisted securities and listed securities that are not actively traded on exchanges (for which the availability of pricing information from commercial sources may be more limited) represent a significant share of banks' holdings, at least in the case of Italy. For these securities a dedicated strategy must be developed to derive data on financial transactions. The most reliable approach to use for the estimation should be decided strictly on the basis of the valuation criteria that are applied to outstanding amounts.

[38] In fact, experience has shown that the quality of the estimates based on indirect methods has been satisfactory, even for a range of ad hoc analyses at the granular level. When drilling down at the level of individual securities, however, substantial differences may materialise for securities that feature high trading activity or high price volatility. Therefore, from a micro statistics perspective the direct collection of transaction data would provide more precise information. At the same time, however, there would have to be concrete analytical needs for this kind of data collection.

Finally, it should also be stressed that the results presented in this document refer only to Italian deposit taking corporations. While a certain degree of caution should be exercised when generalising these conclusions to other institutional sectors, the results would be expected to apply for the euro area as a whole given the size, characteristics and features of the Italian banking market.

Annex 1 – Formalisation of methods to derive transactions on holdings of securities

This annex formalises the different scenarios presented in Section 2 for the collection and derivation of transactions related to securities.[39] In particular, it is assumed that the securities are denominated in euro, meaning that no revaluations are required in relation to changes in exchange rates. The impact of interest accruals on debt securities is not considered either (such accruals are treated as being included in price revaluation effects). In addition, the formulas do not take other changes in volume into account, although this does not imply a loss of generality as the formulas can easily be amended to include this additional factor.[40] In line with the ESA 2010 approach to the valuation of securities holdings, only the case in which securities holdings are marked at market (or fair) value is considered.

Let $(t, t+1]$ indicate the reference period and N_t denote the number of securities at time t. Also, let n^S, n^B and n^I indicate the number of transactions taking place during the period relating, respectively, to sales of securities that are on the balance sheet at time t, purchases of securities that are on the balance sheet at time $t+1$, and intra-period transactions (i.e. relating to securities which are purchased after time t and sold before time $t+1$). The corresponding quantities are denoted as follows:

$N_{s_i}^S$ = the number of securities sold at time s_i that were held at the beginning of the period (i.e. in N_t), with $s_i \in (t, t+1]$ for $i = 1, \dots, n^S$;

$N_{s_j}^B$ = the number of securities bought at time s_j that are held until the end of the period (i.e. in N_{t+1}), with $s_j \in (t, t+1]$ for $j = 1, \dots, n^B$;

$N_{s_l}^I$ = the number of securities bought at time s_l^1 and sold at time s_l^2, with $t < s_l^1 \leq s_l^2 < t+1$ for $l = 1, \dots, n^I$.

The total number of securities purchased, sold and traded within the period can thus be determined, respectively, as $N^S = \sum_{i=1}^{n^S} N_{s_i}^S$, $N^B = \sum_{j=1}^{n^B} N_{s_j}^B$ and $N^I = \sum_{l=1}^{n^I} N_{s_l}^I$. Using N^K to represent the number of securities that are held throughout the period (i.e. securities held at time t that are not sold within the period), it may be seen that the following identities hold:

$$N_t = N^K + N^S \tag{1}$$

[39] The annex generalises examples J and K of Section 5 of the Manual on MFI balance sheet statistics to the case in which more sales and purchases take place during the reference period.

[40] It should be remembered that in this paper other changes in volume do not play a role in the comparisons as the analyses are performed in each quarter, based on the same pool of securities.

and

$$N_{t+1} = N^K + N^B \tag{2}$$

Let p_s indicate the market (or fair) value[41] of the security at time s, where $s \in (t, t+1]$. The outstanding amounts of the securities held at time t can thus be identified as:

$$S_t = p_t \cdot N_t \tag{3}$$

The five methods considered in Section 2 may be formalised as follows.

Method 1. Value all sales and purchases (i.e. including intra-period transactions) during the reference period at their transaction value (the ESA 2010 approach).

Let T^1_{t+1} denote transactions during the reference period, in accordance with Method 1. These transactions are calculated by measuring all sales and purchases at the price at which they take place (i.e. the market (or fair) price). Hence:

$$T^1_{t+1} = \sum_{j=1}^{n^B} N^B_{s_j} \cdot p_{s_j} - \sum_{i=1}^{n^S} N^S_{s_i} \cdot p_{s_i} - \sum_{l=1}^{n^I} N^I_{s_l} \cdot \left(p_{s_l^2} - p_{s_l^1}\right) \tag{4}$$

Now, let R^1_{t+1} denote the revaluations due to changes in prices during the reference period, in accordance with Method 1. Under the assumptions stated above, the following holds:

$$R^1_{t+1} = S_{t+1} - S_t - T^1_{t+1} \tag{5}$$

Substituting equations 4 and 3 and identities 1 and 2 into equation 5 yields:

$$R^1_{t+1} = \tag{6}$$

$$N^K \cdot (p_{t+1} - p_t) + \sum_{j=1}^{n^B} N^B_{s_j} \cdot \left(p_{t+1} - p_{s_j}\right) + \sum_{i=1}^{n^S} N^S_{s_i} \cdot \left(p_{s_i} - p_t\right) + \sum_{l=1}^{n^I} N^I_{s_l} \cdot \left(p_{s_l^2} - p_{s_l^1}\right)$$

Under Method 1, the revaluation thus equals the realised gains on the securities sold during the period (i.e. addends 3 and 4 in equation 6) plus the unrealised gains on the securities held and those bought during the period (i.e. addends 1 and 2 in equation 6).

[41] All prices referred in this annex are "dirty" prices, reflecting the fact that the impact of interest accruals is not considered separately in the analyses.

Calculating transactions or revaluations due to changes in prices according to the ESA 2010 approach is extremely burdensome. As shown in equations 4 and 6, reporting agents would need to report detailed information on the quantities involved in any transactions taking place during the period.

Method 2. Consider sales and purchases made during the reference period excluding intra-period transactions, and value them on an s-b-s basis at the market value on the opening and closing balance sheet dates respectively.

Let T^2_{t+1} denote the transactions during the period, in accordance with Method 2. Under this simplified approach, transactions can be calculated as:

$$T^2_{t+1} = p_{t+1} \cdot \sum_{j=1}^{n^B} N^B_{s_j} - p_t \cdot \sum_{i=1}^{n^S} N^S_{s_i} = p_{t+1} \cdot N^B - p_t \cdot N^S \quad (7)$$

Substituting equations 7 and 3 and identities 1 and 2 into equation 5 yields, for the calculation of revaluations R^2_{t+1} under Method 2:

$$R^2_{t+1} = N^K \cdot (p_{t+1} - p_t) \quad (8)$$

Revaluations due to changes in prices can thus be estimated as the holding gains and losses on securities held throughout the period. As explained above, the number of such securities is equal to the number of securities held at the beginning of the reference period N_t minus the those belonging to the initial pool that are sold during the reference period N^S (identity 1) or, alternatively, to the securities that are held at the end of the reference period N_{t+1} minus those that are bought during the reference period and are held until the end of the reference period N^B (identity 2).

This approach is equivalent to using equation 6 and ignoring the last three addends. Under this approach, there is no need to collect information from reporting agents on individual transactions. Information need only be obtained for the total amount of securities that are held throughout the period or, alternatively, the number of securities purchased that are kept on the balance sheet until the end of the period, or the number of securities in the initial pool that are sold during the reference period (bearing in mind that each of these items can be obtained from the others based on identities 1 and 2).

Method 3. Estimate revaluations for price changes as the holding gains on securities that are kept during the period, approximating the latter on an s-b-s basis as the lower of the number of securities on the opening and the closing balance sheets.

Under Method 3, the calculation of price revaluations is simplified further by estimating the number of securities that are held throughout the period as $min(N_t, N_{t+1})$. The main advantage of this approach is that revaluations are estimated only based on information available from the balance sheet at the beginning and at the end of the reference period. Let R^3_{t+1} denote the revaluations under Method 3. Starting from equation 8, these can be calculated as:

$$R^3_{t+1} = min(N_t, N_{t+1}) \cdot (p_{t+1} - p_t) \quad (9)$$

Under this approach, transactions are estimated indirectly as:

$$T^3_{t+1} = S_{t+1} - S_t - R^3_{t+1} = \quad (10)$$

$$= \begin{cases} p_{t+1} \cdot (N_{t+1} - N_t) & \text{if } N_t \leq N_{t+1} \\ p_t \cdot (N_{t+1} - N_t) & \text{if } N_t \geq N_{t+1} \end{cases}$$

Method 4. Value all sales and purchases made during the reference period at the average of the market price at the beginning and at the end of the reference period.

Method 4 is the method currently favoured for Securities Holdings Statistics. Under this approach, transactions executed during the period T^4_{t+1} are calculated by measuring all sales and purchases at the average market price: $\bar{p}_t = \frac{p_t + p_{t+1}}{2}$. Replacing p_{s_i}, p_{s_j} and p_{s_l} by $\bar{p}_t$ in equation 4 yields:

$$T^4_{t+1} = \sum_{j=1}^{n^B} N^B_{s_j} \cdot \bar{p}_t - \sum_{i=1}^{n^S} N^S_{s_i} \cdot \bar{p}_t - \sum_{l=1}^{n^I} N^I_{s_l} \cdot (0) = \bar{p}_t \cdot (N^B - N^S) \quad (11)$$

Using identities 1 and 2, equation 11 can be written as:

$$T^4_{t+1} = \bar{p}_t \cdot (N_{t+1} - N_t) \quad (12)$$

Hence, substituting equations 12 and 3 into equation 5 yields a calculation under Method 4 for revaluations R^4_{t+1} which is:

$$R^4_{t+1} = N_{t+1} \cdot (p_{t+1} - \bar{p}_t) - N_t \cdot (p_t - \bar{p}_t) = \frac{(N_{t+1} + N_t)}{2} \cdot (p_{t+1} - p_t) \quad (13)$$

Revaluations under this approach are therefore similar to those under Method 3, the difference being that the average of the number of securities held at the beginning and at the end of the period is used to estimate the number of securities that are held throughout the period, rather than $min(N_t, N_{t+1})$. Also in this case revaluations are estimated based on information available from the balance sheet at the beginning and at the end of the reference period only. No information is needed on individual transactions (as is the case under Method 1) or on the total amounts of securities held throughout the period (as is the case under Method 2).

For revaluations under this approach, substituting identities 1 and 2 into equation 13 yields:

$$R^4_{t+1} = N^K \cdot (p_{t+1} - p_t) + N^B \cdot (p_{t+1} - \bar{p}_t) + N^S \cdot (\bar{p}_t - p_t) \quad (14)$$

This expression is similar to equation 6, if p_{s_i} and p_{s_j} are substituted with the average price $\bar{p}_t$, and intra-period transactions are ignored.

Method 5. Value all sales and purchases made during the reference period at the average market price during the reference period.

Method 5 is similar to Method 4, but it uses the average of the daily prices during the reference period $\bar{p}_t^a$ instead of the simple average of the prices at the beginning and at the end of the period. Equations 11, 12, 13 and 14 can be rewritten as:

$$T_{t+1}^5 = \bar{p}_t^a \cdot (N^B - N^S) = \bar{p}_t^a \cdot (N_{t+1} - N_t) \tag{15}$$

and

$$\begin{aligned} R_{t+1}^5 &= N_{t+1} \cdot (p_{t+1} - \bar{p}_t^a) - N_t \cdot (p_t - \bar{p}_t^a) \\ &= N^K \cdot (p_{t+1} - p_t) + N^B \cdot (p_{t+1} - \bar{p}_t^a) + N^S \cdot (\bar{p}_t^a - p_t) \end{aligned} \tag{16}$$

Annex 2 – Differences between the indirect methods and the benchmark

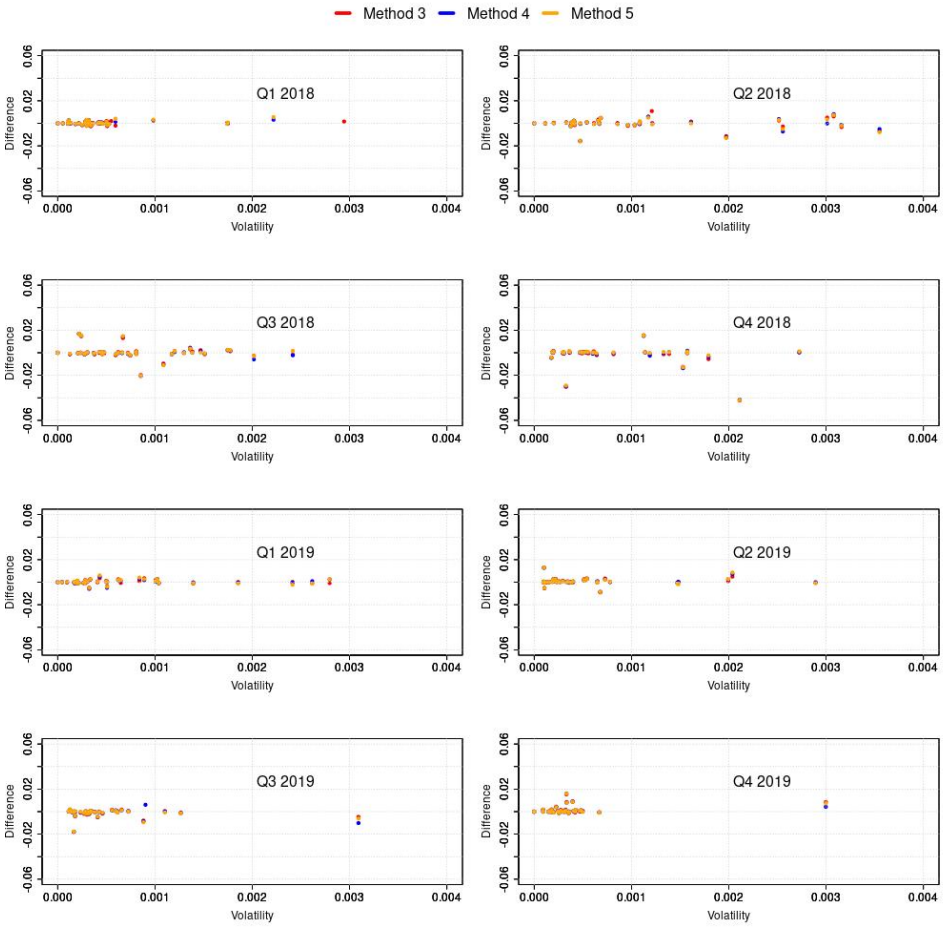
This annex analyses the differences between the indirect methods and the benchmark ESA 2010 methodology in respect of the price volatility (as measured in this paper) of individual securities, for each type of instrument and each quarter under analysis. The differences are shown in relative terms (i.e. as a percentage of the transactions collected under the ESA 2010 methodology). To ensure the charts are as readable as possible, the lower and upper 5% tail of the distributions have been eliminated.

As Charts A2.1-3 show, there seems to be no clear relationship between the size of the differences and price volatility. The correlation coefficients between the size of the differences and price volatility are fairly homogeneous across the methods, ranging, over the period, between -0.122 and 0.172 for short-term debt securities, -0.030 and 0.031 for long-term debt securities and -0.032 and 0.027 for equity (the values are based on the full sample).

Chart A2.1

Short-term debt securities – differences between the indirect methods and the benchmark

(as a percentage of the ESA 2010 transactions)

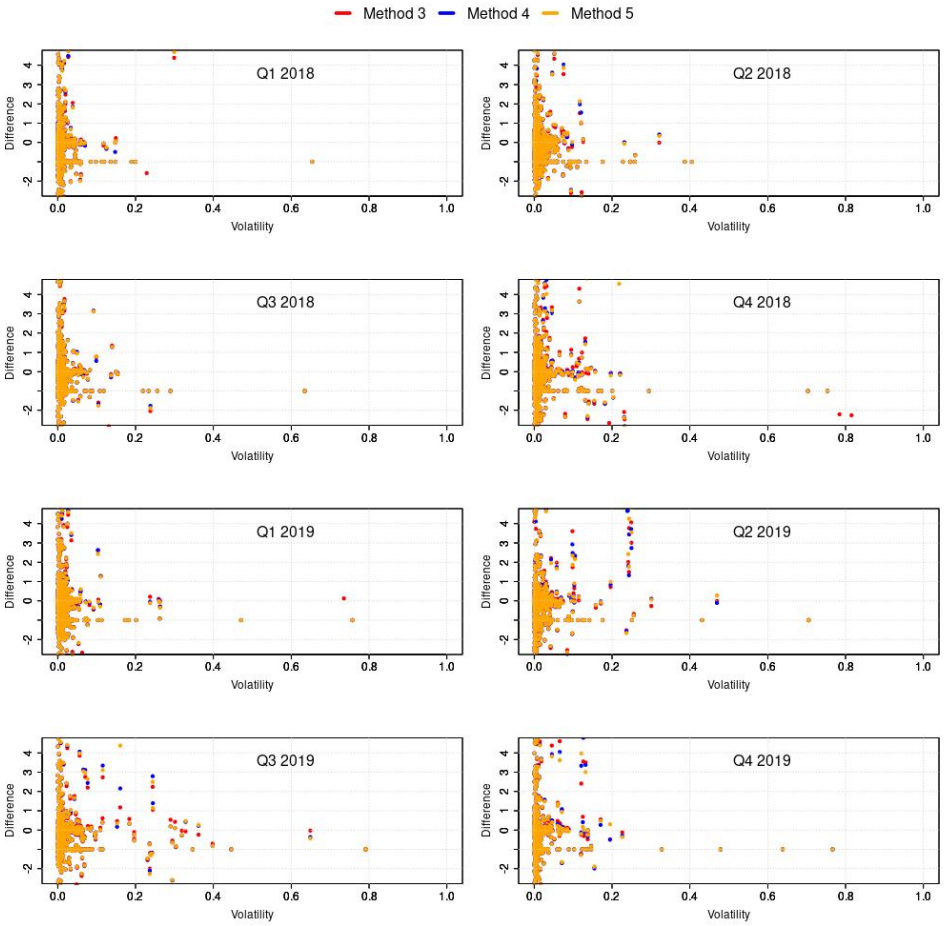


Sources: Banca d'Italia (BSI), ECB (SHSS and CSDB) and authors' calculations.

Chart A2.2

Long-term debt securities – differences between the indirect methods and the benchmark

(as a percentage of the ESA 2010 transactions)

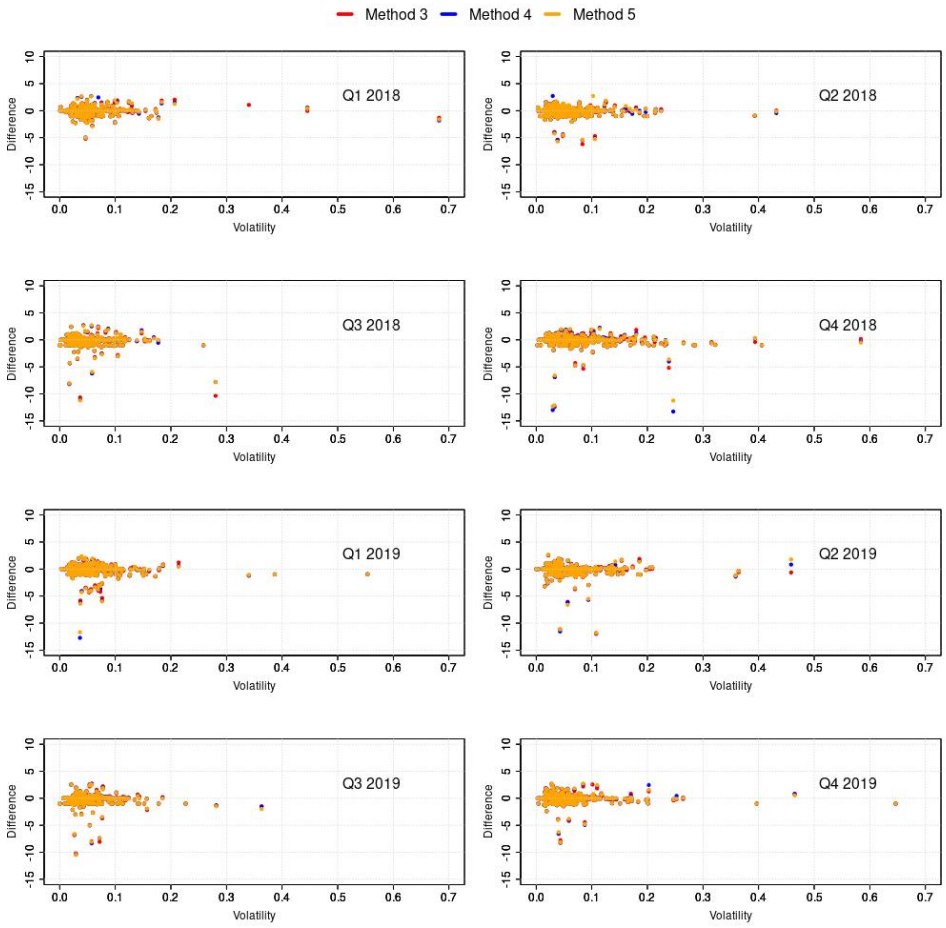


Sources: Banca d'Italia (BSI), ECB (SHSS and CSDB) and authors' calculations.

Chart A2.3

Equity – differences between the indirect methods and the benchmark

(as a percentage of the ESA 2010 transactions)



Sources: Banca d'Italia (BSI), ECB (SHSS and CSDB) and authors' calculations.

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