

FIRST REPORT ON THE LIQUIDITY OF THE SECONDARY MARKET OF ITALIAN GOVERNMENT BONDS, YEAR 2022



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This Report is the result of the activities of the CRIEP research team coordinated by Prof. Luciano Greco and Mr. Filippo Mormando and composed of Mrs. Valentina Catapano and Mr. Francesco Pintus, with the technical support of Mr. Fabrizio Tesseri and Alessandro Iacono from the MEF, and Mrs. Carla Tretto and Mr. Antonio Caruso from MTS Spa. Mrs. Valentina Catapano's PhD scholarship is funded by the European Union - Next Generation EU. The analyses were carried out based upon the database made available by the MEF, within the framework of the institutional cooperation agreement between the MEF, MTS and CRIEP. The final version of the Report is the result of the review and collaboration in the context of the Technical and Scientific Committee of the above-mentioned agreement, composed of Mr. Davide Iacovoni (MEF), Mr. Ciro Pietrolungo (MTS) and Prof. Luciano Greco (CRIEP).

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1. Summary

This Report analyses the trend in liquidity conditions in the inter-dealer market for Italian government bonds (MTS Italy) in 2022. The analysis explores the different dimensions through which the micro-structural liquidity of the market can be assessed: i) quoting activity and availability of market makers to offer competitive prices in the inter-dealer market to execute buy and sell orders (even significant) of government bonds; ii) trading activity on the market platform. This analysis is conducted separately for each government bond segment; specifically, the same metrics have been analysed for each line on which the Italian Treasury operates through bond issues (so-called on-the-run lines): 6-month and 12-month BOTs, short Term (2-year), 3-year, 5-year, 7-year, 10-year, 15-year, 20-year, 30-year and 50-year nominal BTPs, Green BTPs, 5-year, 10-year, 15-year and 30-year European inflation-indexed BTPs, 3-year, 5-year and 7-year CCTeus. The Report focuses primarily on the micro-structural liquidity, defining the metrics to be adopted to analyse the phenomenon, according to market practice and based upon existing scientific literature, thus evaluating, at a later stage, any discrepancies between the liquidity conditions of the various government bond segments. Finally, given the important technological evolution that has increasingly characterised the operations of intermediaries in the financial markets over the last few years, it was found advisable to look at the algorithmic trading of market makers through an innovative interpretation, with a focus on the development and use of auto-hedging functions in the quoting and trading activities of such operators and in the execution of significant flows involving multiple securities in the same flow (so-called basket/block trades).

2. Market maker quoting

In the context of micro-structural liquidity, the report firstly investigates the quoting activity of market makers on the MTS Italy government bond market, the wholesale market selected by the Ministry of Economy and Finance¹ for the evaluation of Specialists in government bonds. This evaluation allows the Ministry not only to verify compliance with the minimum requirements of Specialists in order to keep such status, but also to set the conditions to promote competition among operators when providing liquidity on the market.

The analysis of quoting activity is structured as follows: (i) firstly, a long-term perspective analysis investigates the last fifteen years or so (2006-2022); (ii) then, an analysis covering the 2019-2022 period delves into the effects on market liquidity conditions resulting from the outbreak of the Covid-19 pandemic, the following actions defined by the European Central Bank (ECB) in terms of monetary accommodation and the recent imposition of restrictive monetary policies; (iii) finally, an analysis of the evolution of liquidity in 2022 for each segment of government bonds on which the Treasury operates through bond issues.

The analysis was conducted based upon the database containing all quotations on MTS Italy of traders on the government bonds under analysis, with prices and quantities quoted being recorded every five minutes. The Report analyses the following six indicators of liquidity:

- a. best bid-ask spread, a measure of liquidity ascribable to the tightness of the quoting book, which can calculate the cost to be borne when executing a buy or sell order against the mid-price of the bond;
- b. volume weighted bid-ask (VWBA) spread, a measure that calculates the average price weighted by the quoted volumes associated with each price for both sides of the market (bid and ask). The VWBA spread is a multidimensional indicator of liquidity, i.e., it is able to capture changes in the quoting book by traders both in terms of quoted bid-ask spread and quoted volumes;
- c. volume-weighted bid-ask spread in relation to the daily volatility of the bond (VWBA spread/volatility), a multidimensional liquidity measure capable of quantifying the extent of the variation in the VWBA spread justified by different market volatility rates and the extent relating to a more conservative market maker approach in terms of liquidity provision. The volatility index used for each bond is the daily variation between the minimum and maximum mid-price;
- d. two indicators of quoting book depth: (i) the overall volumes quoted on the platform and (ii) the quoted volumes associated with the top three best prices as a percentage of the overall

¹ For more details, see Ministerial Decree 853355 of 1 March 2011, available at: https://www.dt.mef.gov.it/debito_pubblico/normativa/.

volume quoted. This measure aims to calculate the proportion of volumes quoted at relatively competitive prices;

- e. the slope, a multidimensional indicator calculated as the ratio of the difference between the best and worst bid (ask) and the overall quoted volumes excluding those relating to the best bid (ask). This measure allows assessing the marginal cost for the execution of a sell (buy) order at the worst bid (ask) price compared to the best market price.

The above measures, chosen from a sample of around 30 indicators of liquidity, are believed to be able to provide a clear picture of the liquidity phenomenon and its evolution².

2.1 The 2006-2022 period

The analysis of the 2006-2022 period provides a long-term view of the quoting activity of market makers by framing 2022 within the last fifteen years or so. In this regard, 2006 was selected as a benchmark year in the investigation of the liquidity conditions of the wholesale market for government bonds prior to the financial crisis of 2007-2008. This section analyses the main phenomena detected during this period, referring to previous contributions by CRIEP for a more in-depth and accurate analysis of the 2006-2016 decade (Mormando, 2017; Mormando, 2018). Below are the results of the analysis covering the 10-year BTP alone, an issue included in a specific database covering the entire 2006-2022 period.

The analysis of the trends of the six liquidity indicators outlined above reveals a worsening trend in wholesale market liquidity conditions for government bonds during 2022 (Figure 1). This trend was found to be a gradual phenomenon, with no negative peaks of short-term liquidity reduction, which were detected at some points during the previous 15 years (2008 crisis with the default of Lehman Brothers, the European sovereign debt crisis in the 2010-2012 period, volatility related to political instability following the 2018 elections and, finally, the outbreak of the Covid-19 pandemic in Europe in February 2020).

Downward trends in liquidity began during the second half of 2021, after the market had been able to experience very positive liquidity conditions in the previous twelve months, which for some liquidity indicators were fully in line with typical pre-2008 market levels - a period in which the government bond market was deemed to have experienced excellent liquidity conditions.

² Starting from the metrics presented by Coluzzi et al. (2008), the aforementioned liquidity measures were selected with the aim of providing a smart yet comprehensive representation of the different sizes (in terms of prices and quoted quantities) of the liquidity phenomenon. During the selection, the research team based its work on the analyses and suggestions shared by the participants to the Market Committee, in particular those shared during the meeting held on 21 October 2022. Further liquidity measures will be made available, after the publication of the Report, in an online Appendix at: <https://www.criep.eu/appendice-online-al-rapporto-criep-mef-mts/>. Although the Report sometimes discusses the possible causes of the phenomena observed, the precise identification causes of analysed liquidity dynamics is beyond the scope of this Report. Nevertheless, similar scientific analyses would be very useful considering that, with particular reference to the Italian government bond market, they are scarcely present in the recent scientific literature (Mormando and Greco, 2020) or date back to the period prior to the introduction of the euro (Scalia, 1998a; 1998b).

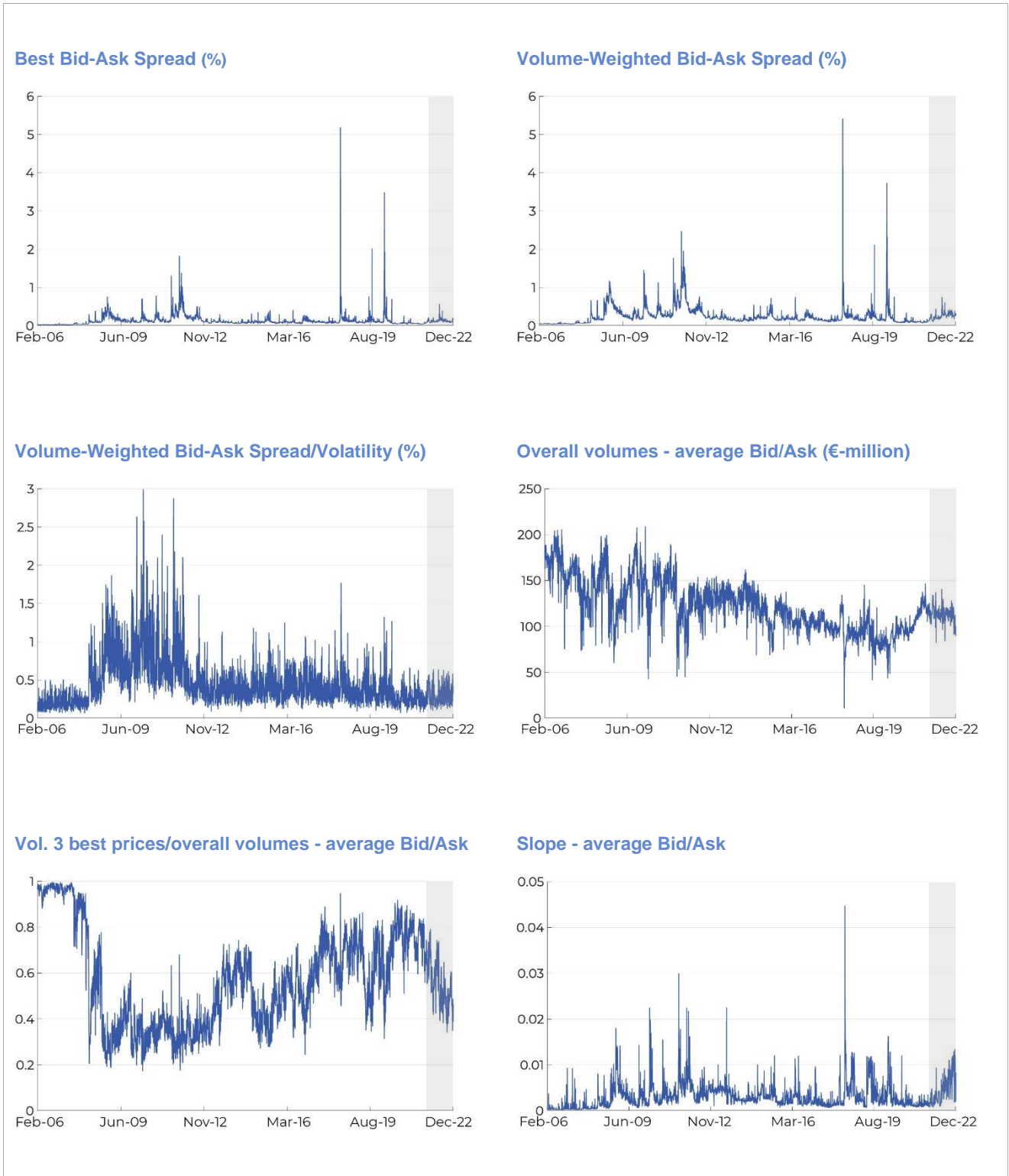
However, the market liquidity began to gradually deteriorate as from summer 2021, especially on the multidimensional indicators above outlined (VWBA spread and slope) and on the quoting book depth indicators (volumes relating to the three best prices out of the overall quoted volumes).³

As mentioned, this trend started at the end of 2021 along with the increase in Italian and European government bond rates, as investors anticipated the beginning of a period characterised by restrictive monetary policies adopted by western central banks, which then fully started during 2022. The implementation of restrictive monetary policies by western central banks thus triggered a generalised increase in volatility, not only of Italian and European bonds, but of all global financial assets. In this context, the stability of the liquidity measure VWBA spread/volatility during 2022 suggests that the deterioration detected in the other indicators is partly explained by the increase in the volatility of the financial assets under analysis and not by idiosyncratic Italian or market structure-related factors. Indeed, as market volatility increases, so does uncertainty about the value of the financial asset, hence the need for market makers to quote wider bid-ask spreads to remunerate the liquidity provision service given a context characterised by higher risks.

Finally, the different (and greater) deterioration of multidimensional liquidity indicators compared to the best bid-ask spread suggests that volatility has exacerbated differences in quoting behaviour among the various market makers, with a smaller impact on the more competitive players and a bigger impact on the more conservative primary dealers. The available database, however, does not allow for a precise analysis on the matter.

³ The stability of total quoted volumes reflects a reduction in the average quantity quoted by each primary dealer as three new banks joined the Public Debt Specialist community during 2022. In this regard, reference shall be made to the updates of the list of specialised banks provided by the MEF during 2022 at: https://www.dt.mef.gov.it/debito_pubblico/specialisti_titoli_stato/elenco_specialisti_in_titoli_di_stato/.

Figure 1: 10-year BTP portfolio (2006-2022 period)



2.2 The 2019-2022 period: the Covid-19 shock and the ECB's monetary policies

This section provides an in-depth look at the evolution of liquidity conditions over the three-year period 2019-2022, specifically selected to assess the events characterising the inter-dealer market during the outbreak of the Covid-19 pandemic, the following actions defined by the ECB in terms of monetary accommodation and the more recent adoption of restrictive monetary policies. The last three years have unquestionably been characterised by major global, economic, geopolitical and social upheavals, and therefore deserve a specific econometric analysis to identify structural changes in wholesale market liquidity conditions for government bonds.

In this context, in addition to analysing the dynamics characterising the six liquidity indicators detailed above, we have adopted the structural break test proposed by Bai and Perron (1998). This test allows identifying the number and the position of structural breaks in time series of the liquidity indicators analysed. Compared to other statistical strategies, this analysis allows investigating the presence of structural breaks in time series with no prior awareness of their position and thus without the need to predetermine dates to check potential changes in the mean of time series.

A preliminary graphical analysis of the time series (Figure 2) shows that:

- I. at the end of February and beginning of March 2020, all indicators show a sudden deterioration in micro-structural liquidity (wider best bid-ask spread and VWBA spread, higher slope, sharply decreasing quoted volumes);
- II. as on previous occasions, the time asymmetry characterising liquidity deterioration movements (sudden and sharp) is followed by recovery phases (gradual and longer);
- III. the liquidity levels achieved by the liquidity recovery phase (from June 2020 onwards) are, however, better than the levels detected in the months prior to the outbreak of the pandemic;
- IV. as already outlined in the previous section, the following reduction in micro-structural liquidity starts in the second half of 2021.

As for 2020 - a year characterised by the outbreak of the Covid-19 pandemic and a consequent strong financial aid granted by the central banks – the application of the Bai-Perron test on the indicators analysed, shows that:

- I. due to the brevity of the period characterised, on the one hand, by the Covid-19 shock that quickly impacted the resilience of the financial markets and, on the other hand, by the ECB's monetary policies adopted on 12 and 18 March 2020⁴, the test does not identify a clear

⁴ The press releases relating to the two ECB meetings held on 12 and 18 March 2020 can be found, respectively, at: <https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.mp200312~8d3aec3ff2.it.html> and https://www.ecb.europa.eu/press/accounts/2020/html/ecb.mg200409_1~baf4b2ad06.it.html.

deterioration/improvement cycle of either the VWBA spread or the other liquidity indicators in the period between February-April 2020;

- II. the only exception relates to the relative depth indicator (volumes associated with the three best prices compared to total quoted volumes), which shows a structural worsening of the indicator on 27 February 2020 followed by an improvement on 15 June 2020;
- III. on the other hand, the test detects structural breaks on all measures analysed, with a positive sign in the period from 22 April to 3 July 2020: for statistical purposes, liquidity conditions began to improve one month after the definition of financial accommodation measures adopted by the ECB in March;
- IV. this improvement mainly crystallised into an overall recovery in the total volumes quoted by primary dealers, which in the period affected by top volatility had fallen to around €50 million/day on average (well below the minimum expected amount of €80 million⁵), and into a simultaneous reduction in the best bid-ask spread, an indicator of quoting book tightness ascribable to the quotations of the most competitive market makers. At a later stage (from 30 April to 6 July 2020), a gradual improvement began to be reported in some liquidity indicators in the other multidimensional (VWBA spread and slope) and relative depth measures (volume quoted on the first three prices compared to the overall volume quoted), which provides the best evidence of a widespread restored confidence of all primary dealers in offering the market competitive execution prices.

The above analysis therefore suggests the strong peculiarity of the microstructure liquidity trend in the period between February-June 2020: the levels reached during the negative peaks detected in the late February/early March sessions are in line with the levels detected in other past shocks (see Figure 1), yet the ECB's action - between 12 and 18 March 2022 - allowed the market to fully recover good liquidity conditions in the following quarter. Important though the ECB intervention was, it is nevertheless worth noting the asymmetry of the deterioration cycle (sudden and concentrated in a few sessions) and subsequent (gradual) recovery of liquidity conditions, even in the case of the Covid-19 shock.

The test does not reveal any structural breaks in the selected indicators up to the end of October 2021, except for a structural increase in overall quoted volumes since 9 April 2021. The latter phenomenon is most likely ascribable to the quoting activity by Candidate Specialists. In fact, three new Specialists joined as from May 2022. The accreditation process provides for a minimum period of six months as a Candidate Specialist, a phase in which the candidate bank shall perform quoting

⁵ In the context of the evaluation criteria of Specialists defined by the Department of the Treasury for the activity carried out on the secondary market, for the purposes of calculating the quotation quality index (criterion defined to give a higher score to primary dealers who contribute on the quotation day with more competitive bid and ask prices) and the contribution to market depth (criterion that gives a higher score to primary dealers who associate greater volumes to their bid and ask proposals), defined respectively in articles 11 and 14 of the so-called Specialists' Evaluation Criteria Decree, the minimum quoted quantity associated to each buy/sell proposal by primary dealers is required to be at least €5 million. Therefore, €80 million represents the result of the product of this minimum quoted quantity threshold, for the purposes of the two criteria outlined above, and the 16 primary dealers existing at the time. The Specialists Evaluation Criteria Decree can be found at: https://www.dt.mef.gov.it/export/sites/sitodt/modules/documenti_it/debito_pubblico/specialisti_titoli_di_stato/Criteri_di_Valutazione_Specialisti_anno_2022.pdf.

and trading activities similarly to other primary dealers and on which the Treasury plans assessment in order to accept the application for accreditation as an Italian debt specialist⁶. In this regard, the depth measures dynamics (both in absolute and relative terms), during the second half of 2021, may have been influenced by the more or less conservative attitude that Candidate Specialists may have had in quoting activity compared to other primary dealers. The database used does not allow recognising the behaviour of individual banks, and in any case, such an in-depth study is not one of the Report's objectives.

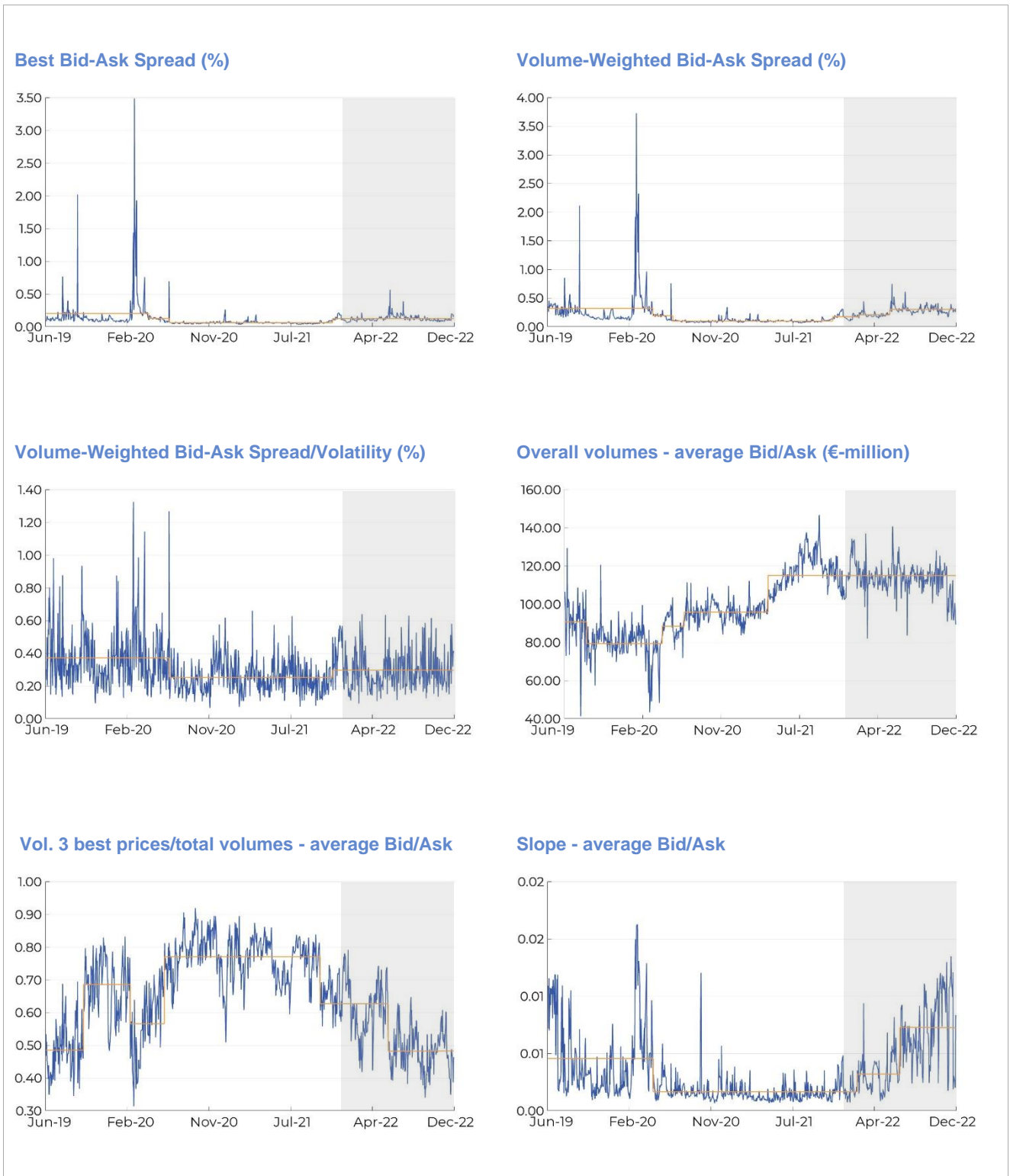
Finally, starting in the autumn of 2021, the test has identified a cycle of structural breaks of reduced market liquidity. In this cycle - unlike previous deterioration events – the dates of structural breaks do not fall within a short period of a few sessions. Indeed, the test identifies nine structural changes in liquidity indicators from 27 October 2021 to 1 July 2022, with a higher concentration of deterioration events by the end of 2021. This cycle of deterioration is attributable to restrictive expected changes in monetary policy, anticipated by market players, which generated a significant increase in government bond yields along with market volatility. It is worth noting that the volatility-adjusted VWBA spread indicator reveals a single structural break in December 2021 and a following substantial stability throughout 2022. In this perspective, the most recent year of the analysis does not appear to have been significantly affected by liquidity erosion dynamics closely linked to the specific risk of Italian government bonds.

It is also worth considering that the analysis does not reveal a concentration of structural breaks on the days of the start of the Russian military aggression against Ukraine (24 February 2022). Indeed, as far as this period is concerned, the analysis reveals a single structural break for the slope (17 February), with no other statistically relevant changes in the other liquidity indicators. In all probability, quotations have worsened in the tail of the worst prices, with one or a few dealers structurally changing their quoting activity in the market with a more defensive approach. Lacking negative effects on other liquidity indicators, this phenomenon remains limited and does not affect the entire primary dealer community.

It is finally worth noting that no structural breaks (either positive or negative) were detected in the run-up to the main Italian political event of 2022: the government crisis in July 2022 and the national elections held at the end of September. In this scenario, the test result proves that the deterioration in liquidity conditions detected on the MTS Italy is not an issue ascribable to dynamics peculiar to Italian government bonds and Italian credit risk.

⁶ See the Specialists Evaluation Criteria Decree, available at: https://www.dt.mef.gov.it/export/sites/sitodt/modules/documenti_it/debito_pubblico/specialisti_titoli_di_stato/Decreto_Dirigenziale_Specialisti_-_Selezione_e_Valutazione_xnov_2011_e_modifiche_dic_2021x.pdf.

Figure 2: 10-year BTP structural breaks (2019-2022 period)



Liquidity indicator	Date	Mark
Bid-Ask spread	24-Apr-20	+
	01-Jul-20	+
	06-Dec-21	-
Volume-Weighted Bid-Ask spread	30-Apr-20	+
	06-Jul-20	+
	30-Nov-21	-
	23-Feb-22	-
	01-Jun-22	-
VWBA spread / Volatility	01-Jul-20	+
	06-Dec-21	-
Overall volumes	14-Aug-19	-
	22-Apr-20	+
	03-Jul-20	+
	09-Apr-21	+
	30-Sep-19	+
Volumes quoted at the three best prices / overall quoted volumes	27-Feb-20	-
	15-Jun-20	+
	27-Oct-21	-
	02-Jun-22	-
Slope	04-May-20	+
	17-Feb-22	-
	01-Jul-22	-

2.3 2022 and the individual segments

Below is an analysis of the performance of the six liquidity indicators presented above for each of the segments on which the Treasury operates through on-the-run issues.

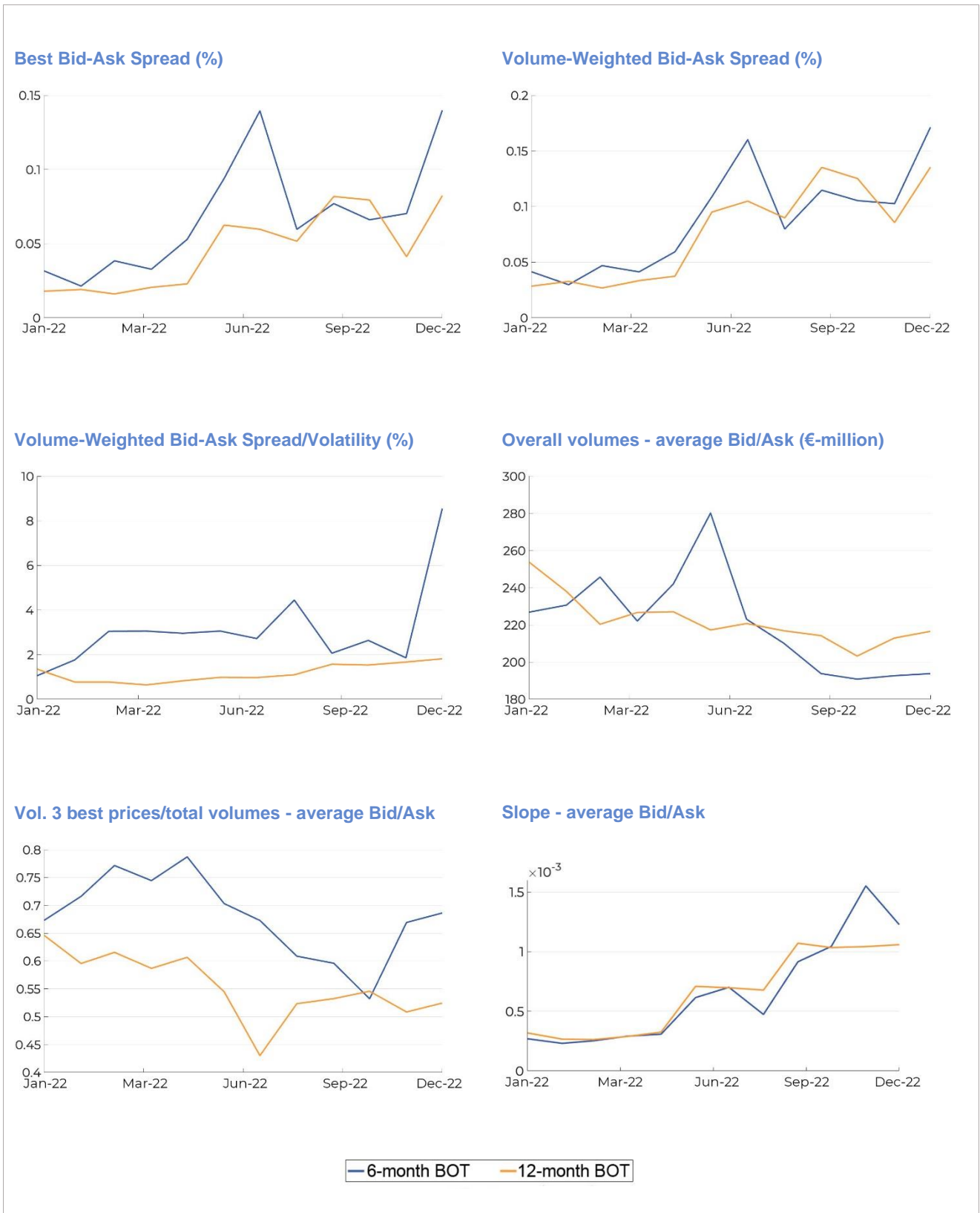
BOT

As regards the 6-month and 12-month BOTs, a general trend characterised by deteriorating liquidity conditions can be observed during 2022 (Figure 3), consistent with the elements analysed above. More specifically, the tightness measures (best bid-ask spread and VWBA spread) and the slope show that the deterioration in liquidity conditions starts from the second quarter of the year, with negative peaks recorded in June and December.

As for depth indicators, a greater volatility can be seen in the overall quoted volumes of the 6-month BOT, which follows a bullish trend in the first months of the year, and a subsequent sharp decline with a monthly average value constantly below the monthly figure for the 12-month BOT. Even in the case of the relative depth measure (quoted volume relating to the three best prices out of the total quoted volume), a discrepancy can be seen between 6-month and 12-month BOTs: in the case of the 6-month BOT, the ratio rose up to 80% in the first five months of the year, while the same measure for the 12-month BOT fell to 60%.

Finally, it is interesting to take a look at the result of a comparison of the VWBA spread and VWBA spread/volatility indicators between the two segments: while, on the one hand, the first indicator shows substantial homogeneity in both level and trend for the two segments, on the other hand, the structural discrepancy found in the case of the VWBA spread indicator in relation to volatility appears to suggest a substantial difference in the level of volatility on the two segments. This might be due to the different effects of the ECB's rate hike cycle expectations on the two segments during 2022, with a greater effect on the longer maturities which were compelled to consider more rate hikes within the maturity of the securities.

Figure 3: BOT



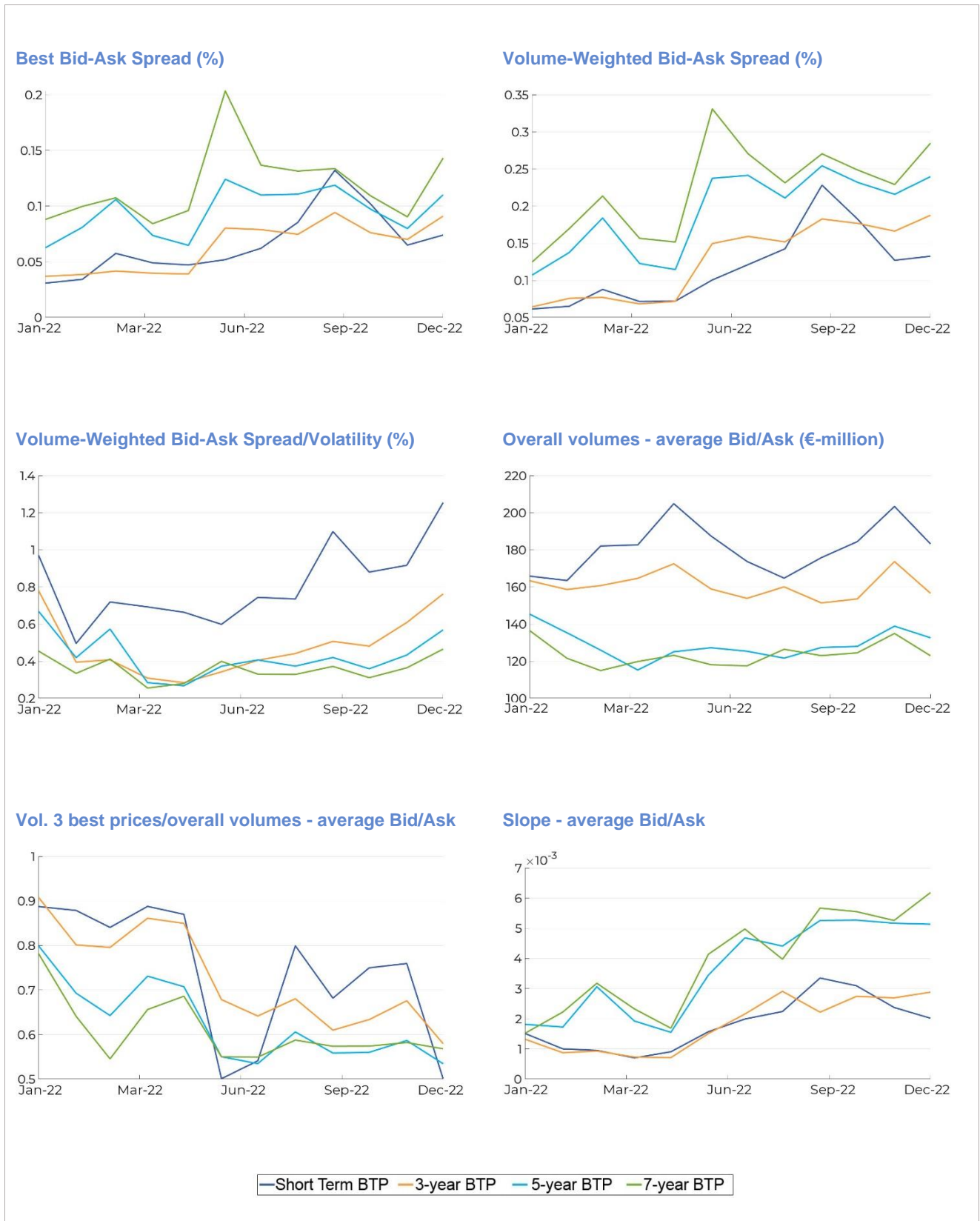
≤ 7-year BTP

As for BTPs with a maturity of seven years or less, the liquidity indicators analysed on the short term (2-year), 3-year, 5-year and 7-year BTPs are analysed. Compared to the BOT segment, the liquidity condition deterioration trend is more homogeneous during 2022 (Figure 4). May, June and December are the months experiencing the worst liquidity conditions.

As the duration of the line increases, worse liquidity conditions emerge. Based on the levels and trends observed by the metrics on short-term BTPs and 3-year BTPs, these segments appear to be perceived as very similar by market makers. However, as we look at tightness (best bid-ask spread and VWBA spread) and depth measures (both the total volumes quoted and the percentage of volumes quoted on the three best prices), we can identify a greater volatility of liquidity conditions in the Short Term BTP segment: in relative terms compared to other segments, the Short Term BTP shows, during negative market phases, a greater reaction and a greater deterioration of liquidity conditions than in positive market phases, in which it is found to be the most liquid segment.

As for the 5-year and 7-year BTP lines, these segments also seem to experience highly correlated liquidity conditions, whose metrics under analysis show very similar values. The longer duration of the bonds and the following higher intraday volatility of the bonds concerned, cast some light into the larger bid-ask spreads in the quoting book and the deteriorating trend recorded during 2022. In this regard, it is interesting to note that in both tightness measures (best bid-ask spread and VWBA spread), the indicator takes on a systematically higher average monthly value in the case of the 7-year BTP (consistent with the longer duration of the bond) than in the case of the 5-year BTP, while the opposite can be noted when analysing the VWBA spread in relation to volatility. In this context, market makers' quotations appear to embrace an ex-ante risk management approach assessed in terms of financial duration, not strictly linked to the actual risk (measured by the bonds' intraday volatility).

Figure 4: ≤ 7-year BTP

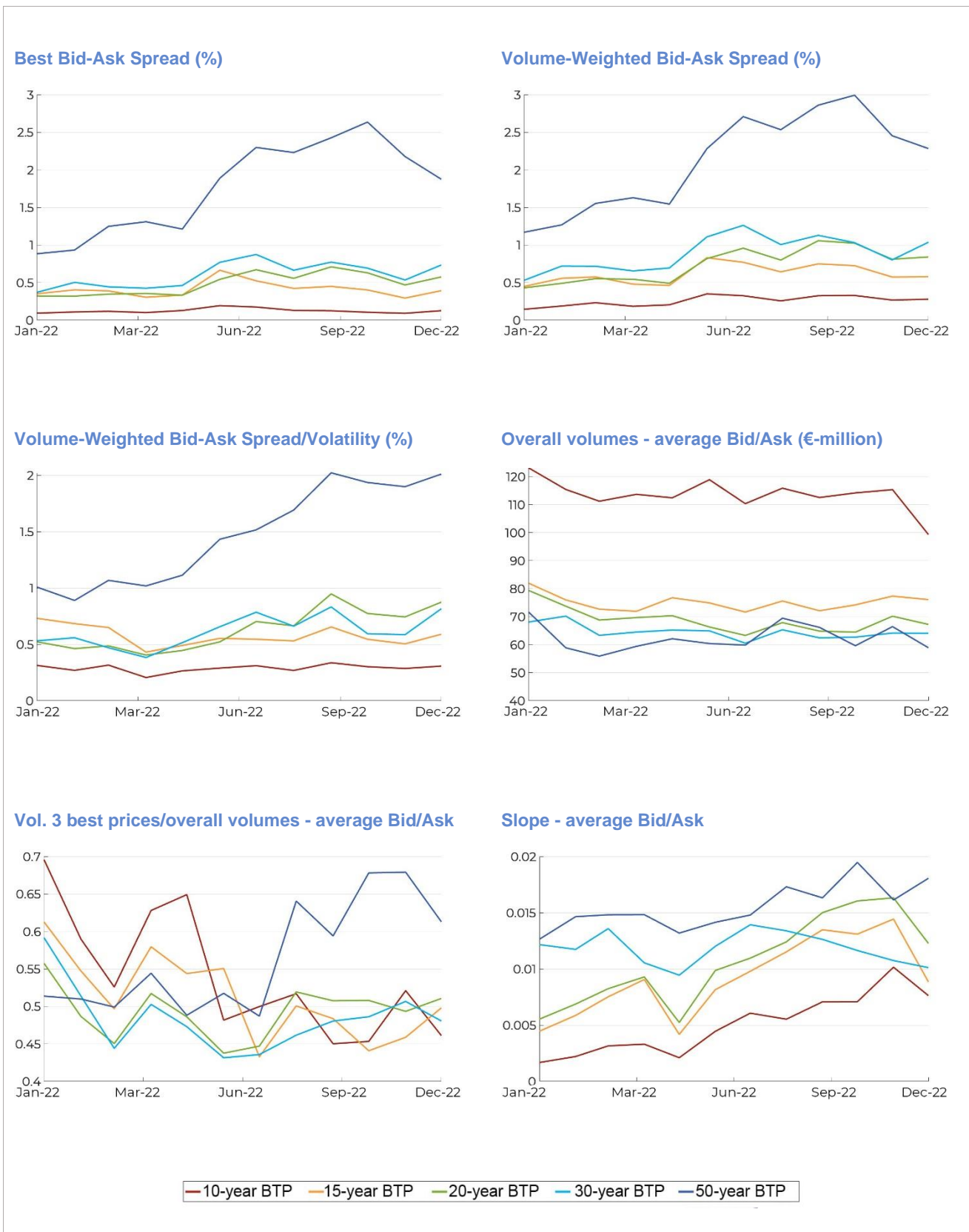


≥ 10-year BTP

For BTPs with a maturity of ten years or more, 10-year, 15-year, 20-year, 30-year and 50-year BTPs are analysed. Below are the trends identifiable in the five segments for the different metrics analysed (Figure 5):

- I. the 10-year BTP line performs better and sharply differs from the liquidity conditions of the 15-year, 20-year and 30-year BTPs (evidently perceived by market makers as equivalent lines, such as not to require a structural differentiation in quoting activity), which in turn show structurally better liquidity conditions than the 50-year BTP. However, these differences do not appear to be correlated with the longer duration of the bonds (for example, in the case of the slope, the 30-year BTP shows the highest value among the three 15-, 20- and 30-year benchmarks at the beginning of the year, although differences tend to fade over the course of the year, until complete reversal as from September, with the 20-year BTP showing the highest liquidity figure), but rather with a more or less conservative behaviour by players that might be partially ascribable to differences in terms of soft regulation through the Specialists' evaluation criteria defined by the Treasury (e.g. the minimum amount required for evaluation purposes in the case of 10-year BTPs is higher than for BTPs with a longer maturity);
- II. in regard to the tightness measures of the quoting book, the worsening trend of the indicators during the year is more evident in BTPs with longer maturities than the 10-year line;
- III. conversely, in the case of the slope, the sharpest trend of liquidity erosion, while remaining low, persists for the 10-, 15- and 20-year lines. This difference compared to the quoting book tightness measures outlined above, might be ascribable to the more prudent behaviour by the less competitive dealers in terms of quoting activity. In this context, we can assume that as the financial duration of bonds decreases, the degree of diversification of primary dealers' quoting strategies increases: while, on the one hand, different behaviours in terms of liquidity provision are less frequent among primary dealers on bonds with longer maturities, the segments with shorter maturities (e.g. 10 years) allow clearly separate not only the most competitive dealers, but also those showing a more consistent approach in providing liquidity to the market over time;
- IV. as for depth indicators, the analysis reveals no significant trends for overall quoted volumes, a poorly volatile liquidity indicator, except for a downward trend in quoted volumes on the 10-year BTP, which fell from €120 million at the beginning of the year to €100 million in December. As for relative depth indicators, the downward trend in the concentration of volumes on the best prices is sharper as the financial duration of bonds decreases, and in the case of the 50-year BTP the indicator suggests an upward trend which, however, when combined with wider bid-ask spreads, shows the overall lower competition of dealers in providing liquidity to the market.

Figure 5: ≥ 10-year BTP



Green BTP

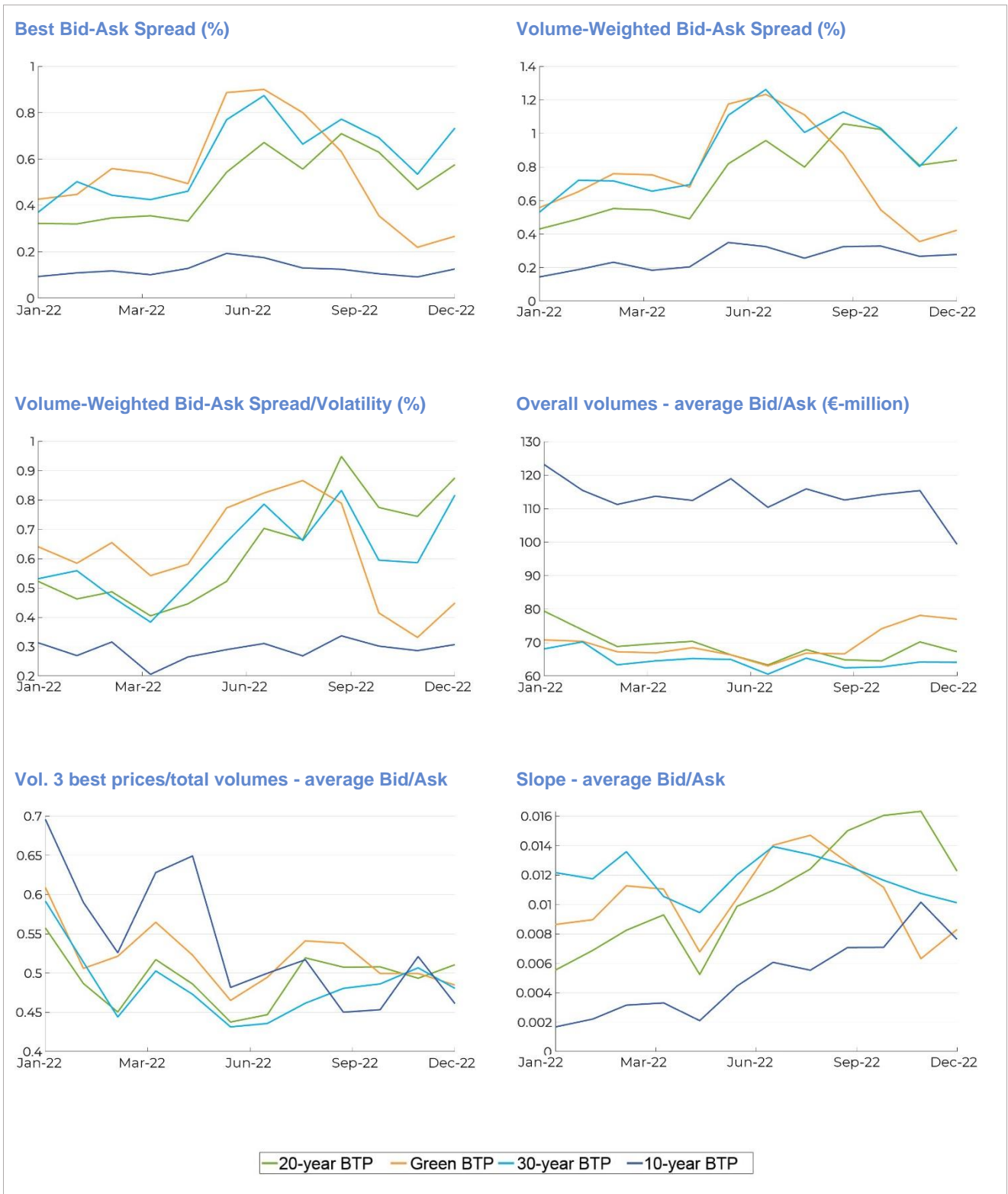
In 2021, the Italian Treasury issued the first Green BTP, a government bond maturing in April 2045 (with a residual life of 24 years, i.e., different from the benchmark lines of the traditional 20-year and 30-year BTPs). In September 2022, the Treasury then offered a second green bond maturing in April 2035 (with a residual life of approximately 12½ years). Green BTPs, one of the main innovations in the Treasury's offerings in recent years, were issued to fund specific items of the state budget, in line with the goal of achieving climate neutrality by 2050 and, more generally, with the objectives set by the European Green Deal (MEF, 2021).

These government bonds are regularly listed on MTS Italy with the same rules applied to market makers and primary dealers for traditional BTPs. Green bonds, in terms of liquidity conditions, show a trend consistent with traditional bonds with similar maturities (20- and 30-year lines for the first Green BTP, 10-year for the most recent issue). The graphs below (Figure 6), show that the first green benchmark bond was replaced with the new issue in September. Therefore, the liquidity indicators from September onwards converge towards the 10-year BTP levels.

Although the main trends of liquidity indicators for Green BTPs are consistent with those of traditional BTPs, we can identify some apparently recurrent differences: (i) tightness measures and, specifically, the VWBA spread/volatility suggest a structurally wider range of quotations compared to traditional bonds; (ii) conversely, the volumes quoted on the three best prices compared to total quoted volumes and the slope suggest a better quality of the quoting book. Therefore, this combination of factors suggests less competition between dealers in the quoting activity (wider bid-ask and hence prices offered by market makers more focused on more conservative prices), which may partially prove the well-known difference in the distribution of Green bonds to more strategic portfolios and investors with a long-term investment plan (e.g. pension funds, insurance companies, central banks and government institutions) compared to traditional BTPs, which reduce the very demand for liquidity from investors themselves⁷.

⁷ In this regard, please refer to the MEF press releases on the details of syndicated placements of Green BTPs and, more generally, the statistics provided by issuers of ESG-compliant instruments.

Figure 6: Green BTP



BTP€i

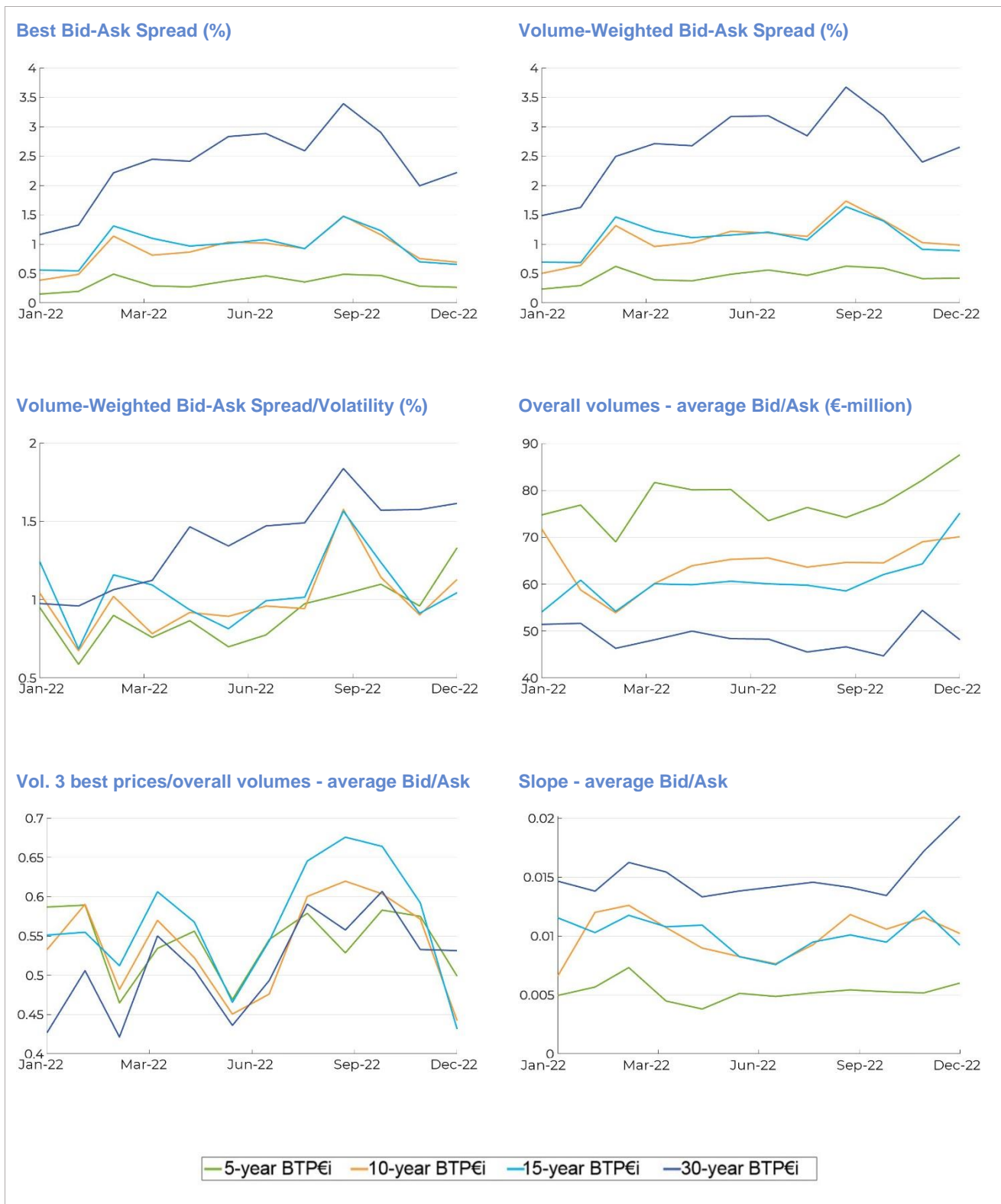
Italian public debt is mostly issued through fixed-rate bonds (about 77%), while about 23% is issued through floating-rate instruments (MEF, 2022). Among them, the Italian Treasury issues European inflation-indexed bonds with on-the-run lines with 5-, 10-, 15- and 30-year maturities.

Firstly, the analysis shows fewer deteriorating trends in liquidity levels during 2022 (Figure 7) compared to nominal BTPs. This phenomenon is probably attributable to the worse liquidity that structurally characterises the BTP€i segment compared to traditional bonds. Indeed, the comparison of the levels of the metrics between the individual BTP€i benchmarks and the related levels of nominal BTPs with the same maturity, clearly reveals the structural difference between the two segments⁸. This phenomenon can be ascribable both to structural differences between the two segments (the linker segment is a smaller market than the fixed-income securities market, a difference due both to lower investor participation and a limited number of issuers; moreover, the allocation of inflation-indexed could be proportionally higher than nominal BTPs in strategic portfolios, thus leading to a reduced trading activity), and to risk-related factors peculiar to linker bonds, since they appear to be more exposed to the issuer's credit risk as they would also pay the inflation component accrued over the life of the bond.

Finally, it is interesting to note the segmentation of the liquidity measures of the different maturities depending on the longer duration of the bonds: in terms of the size of the quoting book, the overall quoted volumes and the slope, the 30-year line is clearly different from the other three lines, with the 15-year BTP€i in line with the levels of the 10-year line rather than the 30-year line. As for quoted volumes associated with the three best prices compared to the overall quoted volumes, the 15-year BTP€i appears to be the segment with the highest concentration of quoted volumes at the most competitive prices for the most part of 2022 (between February and November). In this context, given the fully comparable level with the 10-year BTP€i in terms of size of bid-ask spreads, the 15-year BTP€i line appears to have offered investors a better liquidity profile than the 10-year benchmark in 2022.

⁸ By way of example, for the 10-year BTP€i the average VWBA spread in 2022 ranged between 0.5%-1.7%, and for the 10-year BTP between 0.5%-0.7%.

Figure 7: BTP€i



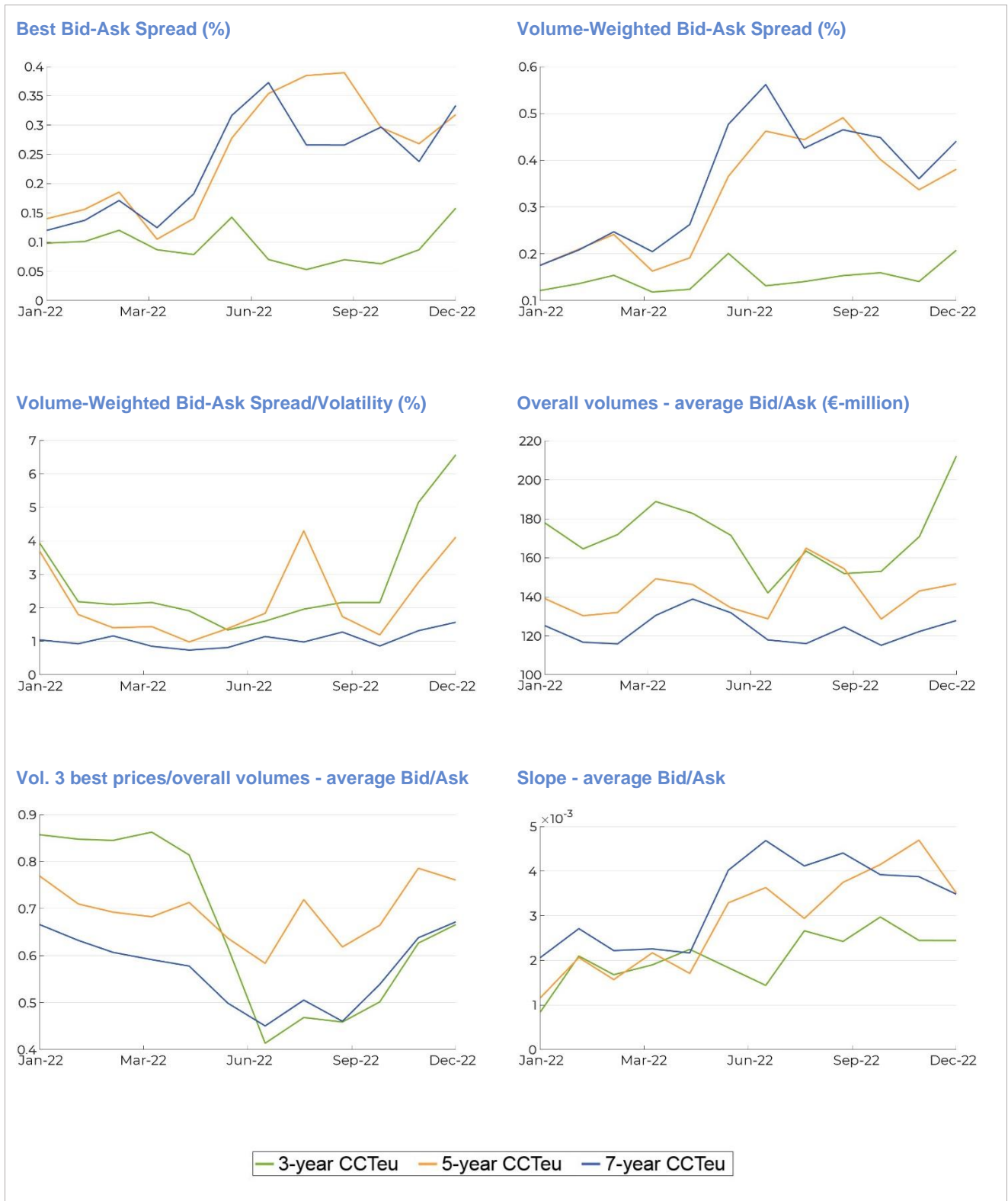
CCTeu

The second segment of floating-rate bonds is the CCTeu, whose bonds are indexed to the 6-month Euribor benchmark. Until 2017, the segment was considered a single benchmark with a 7-year maturity. In recent years, due to the specific conditions of the financial markets and the different dynamics experienced in the demand for floating-rate bonds, the Treasury started redefining the segment as a multi-benchmark segment, i.e., similar to the BTP€i experience. Therefore, the analysis focuses on the three on-the-run lines: 3-year, 5-year and 7-year. Specifically, in the context of the 7-year line, it is worth noting that in 2021 the Treasury issued a new 7-year benchmark (CCTeu April 2029), replacing the previous on-the-run CCTeu April 2026, which in turn became the benchmark bond for the 5-year maturity, and in March 2022 renewed the 7-year benchmark line by issuing the new CCTeu October 2030.

Unlike in the past, when the CCTeu segment experienced smaller changes in liquidity similar to those concerning BTP linkers analysed above, in 2022 liquidity conditions showed clear worsening and improvement trends, particularly for 5- and 7-year CCTeus (Figure 8). As regards the tightness measures, a trend characterised by wider bid-ask price ranges was recorded from April onwards for 5- and 7-year CCTeus. By contrast, the same measures suggest no trends whatsoever for the 3-year CCTeu, whose effective maturity is, however, less than 2 years (the reference CCTeu matures on 15 December 2023). As for depth measures, the analysis highlights a substantial stability of both the overall quoted volumes and the related depth measure: for 5-year and 7-year CCTeus the proportion of quoted volumes on the three best prices turns out to be the same at the beginning and end of the year, with a relative minimum value during mid-year months.

Overall, CCTeu segment shows a trend in liquidity measures more in line with nominal BTPs than for linker BTPs. This condition might be the consequence of the growing investor demand for floating-rate bonds indexed to the 6-month Euribor seen over the last two years, which allowed the Treasury to issue two new benchmarks with maturities slightly longer than 7 years. In this context, the ECB's restrictive monetary policy cycle has triggered a positive maturation process in the sector, with growing demand from end investors and greater confidence on the part of market makers in the liquidity providing service provided to the market.

Figure 8: CCTeu



3. Trading

Trading and exchanges on the wholesale secondary market are the second element of the micro-market liquidity phenomenon. The greater the volumes traded, the greater the liquidity is expected to be.

The trading activity carried out on the MTS Italy platform was analysed through the database containing all contracts concluded, with information concerning the identification of the security and the players, the market side (buy or sell, from the perspective of the price taker who trades, i.e., the aggressor), the price and yield of the contract, the date and time with microsecond accuracy.

In summary, in order to assess different aspects of trading activity, the analysis focused on three different dynamics: i) the trend of monthly volumes traded on the platform; ii) the breakdown by flow size of the volume trend in 2022 compared to the previous year; iii) the effects on the quoting activity of market makers in light of fast market trends and medium-sized trading flows, an analysis that was made possible by the interaction between the quoting activity database and the information on the trading of securities on the platform.

3.1 Trend in trading volumes

Trading volumes on the MTS Italy platform were analysed by subdividing the database by category of security and the related residual maturity in order to take due account of the different risks associated with trading the various instruments (e.g., the longer financial duration). Specifically, Italian government bonds were divided into: BOTs and BTPs with residual maturity of one year or less, BTPs with residual maturity between one year and two and a half years (2-year BTPs), BTPs with residual maturity between two and a half and four years (3-year BTPs), BTPs with residual maturity between four and six years (5-year BTPs), BTPs with residual maturity between six and eight years (7-year BTPs), BTPs with residual maturity between eight and twelve years (10-year BTPs), BTPs with residual maturities between twelve and seventeen and a half years (15-year BTPs), BTPs with residual maturities between seventeen and a half and twenty-five years (20-year BTPs), BTPs with residual maturities longer than twenty-five years (30-year BTPs), BTPs with European inflation-indexed coupons (BTP€i) and bonds with floating coupons indexed to the 6-month Euribor benchmark (CCTeu).

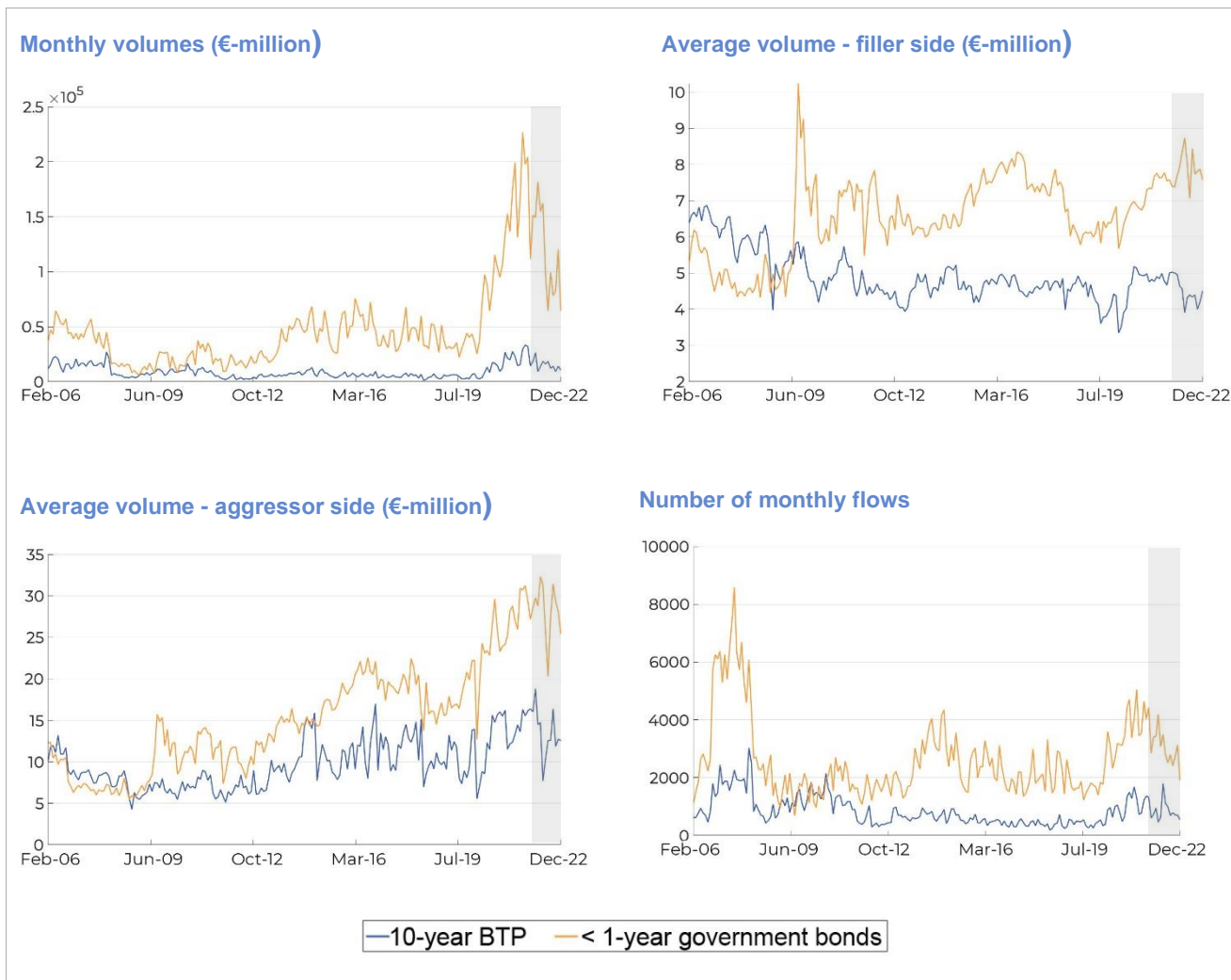
The following analysis firstly focuses on the two 10-year BTPs and government bonds with a residual maturity of less than one year (Figure 9). The trend in volumes in 2022 for both segments is down compared to the previous two years. This reduction is sharper for short-dated securities, which, however, had experienced a fourfold increase in volumes during 2020-2021 compared to 2019. Volumes traded in 2022 are indeed still higher than the levels observed in the years before the pandemic and the related monetary policy interventions.

It is worth emphasising that 2022 can be seen as a bridge into a market condition that is completely different from 2020 and 2021, a two-year period in which the pandemic and the joint intervention of extraordinary monetary and fiscal policy measures to support the economic and financial system profoundly influenced market dynamics. From an historical standpoint, it could be interesting to reflect on what might be the most suitable reference period for 2022 - a year characterised by major global changes and by resolute restrictive global monetary policies - in order to better assess the dynamics inherent in government bond market activity. This analysis does not aim to provide a final and comprehensive answer to this question; therefore, the following analysis will highlight both short-term and long-term trends in trading activity.

The analysis of the average size (both from the aggressor and market liquidity providers' standpoint) and of the monthly number of flows allows investigating into the factors that mostly contribute to the reduction in volumes outlined above. Specifically, for short-dated government bonds, it is possible to report, on the one hand, no downward trends in the average size of their flows, and on the other, the evident downward trend in the number of flows. In this context, the reduction in flows clearly proves an overall deteriorated interest by end investors in these instruments, rather than an effect induced by the worsening liquidity conditions, explored in the section on the quoting activity of market makers, which possibly limited their trading activity.

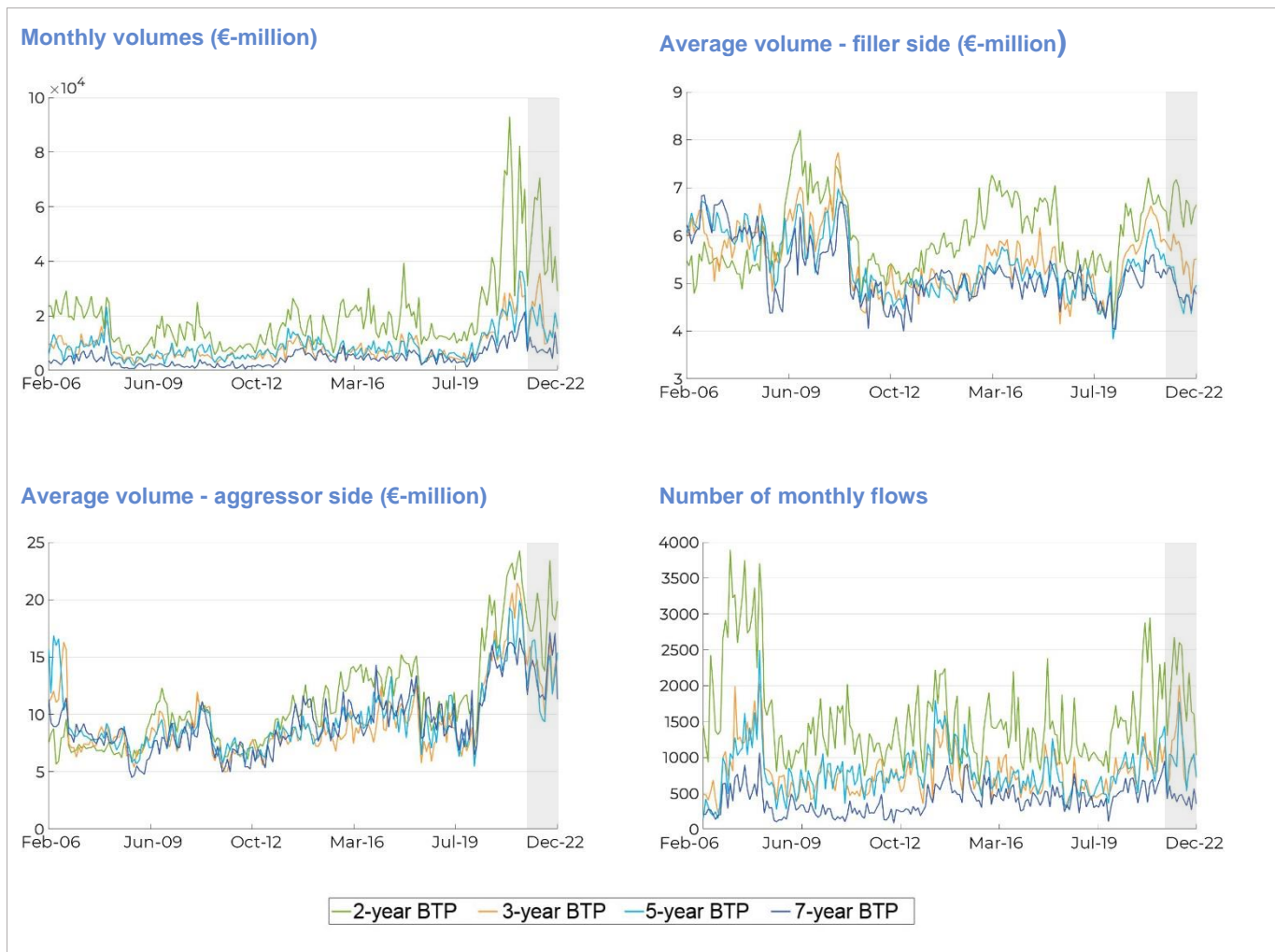
On the contrary, as regards 10-year BTPs, the reduction in volumes is associated with both a reduction in the average flow size (filler and aggressor) and a contraction in their number. In particular, the analysis emphasises the negative peak of the average size of volumes on the aggressor side in May, corresponding to a relative minimum also of the average size flow size on the filler side. In this context, we can highlight the strong interdependence between the choices made by market makers in terms of quoting strategies and the execution strategies of trading flows. In other words, the larger the average size of filler-side contracts (closely related to the average quantity quoted by primary dealers), the larger the average size of aggressor-side flows, with direct effects on an increase in trading activity itself.

Figure 9: 10-year BTPs and < 1 year-government bonds



The segment of BTPs with a maturity of seven years or less shows a general downward trend in volumes (Figure 10), whose intensity fluctuates between the two levels just presented for bonds with a maturity of less than one year and for ten-year bonds. As the duration of the bonds increases, we note a weaker absolute reduction in the overall volumes traded on the platform, with the greatest negative effect found in the 2-year bond segment. In the case of 7-year BTPs, we can note that the reduction in volumes is heterogenous during 2022, with a peak in trading activity in the last quarter of the year (especially in November). As for the average size of flows on the aggressor side, 7-year bonds show an upward trend in the last months of the year (over €15 million). In this context, trading activity in the 7-year line, in spite of declining volumes recorded as from 2021, suggests that traders were still able to execute flows of an increasing size in the second half of the year compared to the first half of the year. The above also applies to 2-year bonds, with a peak of over €20 million recorded in September.

Figure 10: ≤ 7-year BTP

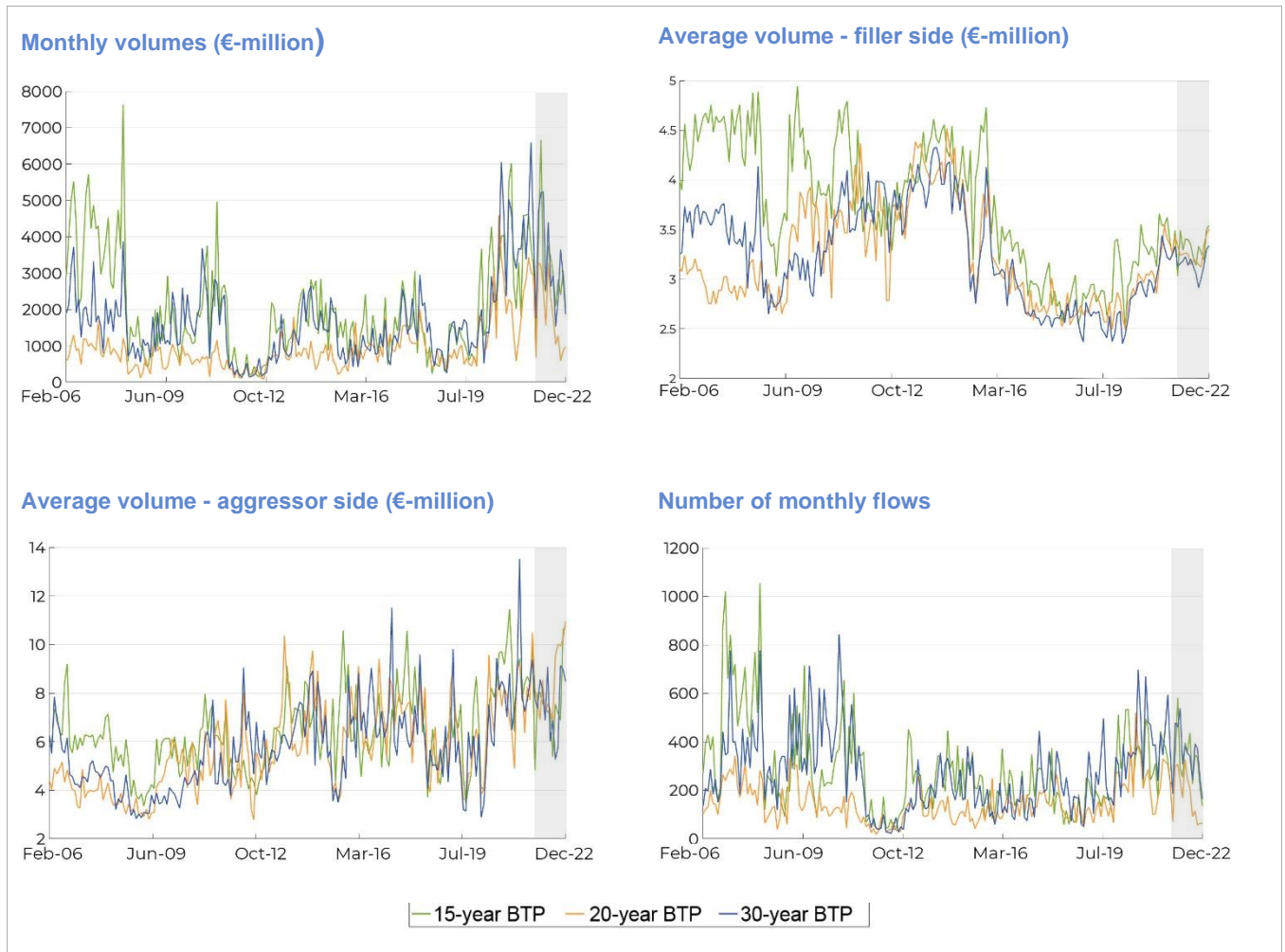


As for BTPs with maturities above ten years, the 20-year line shows the most pronounced reduction in trading volumes, where monthly volumes reach levels similar to the pre-2020 period by the end of the year (Figure 11). Trading activity on the 15- and 30-year lines, while decreasing, remains stably above 2019 levels. Please note that during 2022, the 20-year line was the only one (among the 15-, 20- and 30-year segments) in which the Treasury did not issue new benchmarks. In the case of the 30-year, the new line was launched through a syndicated transaction in January (BTP 2.15% 1 September 2052) for an issuance amount of €7 billion; in the case of the 15-year bonds, the new benchmark (BTP 3.25% 1 March 2038) worth €5 million was launched in May, issued through a syndicated transaction. In 2022, offerings by the Treasury thus seem to be a relevant factor to better understand the different trading activity in bonds with maturities above ten years.

Moreover, the better liquidity conditions of the long-term segments in relative terms compared to the other segments – partially covered in the section on the quoting activity of market makers - can also be seen in the trends recorded in the average size of flows executed on the aggressor side and of contracts executed on the filler side. In both cases, the indicators show no significant downward

movement compared to the average levels of the previous two years, confirming the substantial stability in the approach to trading by market participants and the maintenance of good liquidity conditions, favourable to trading in the bonds of the segment.

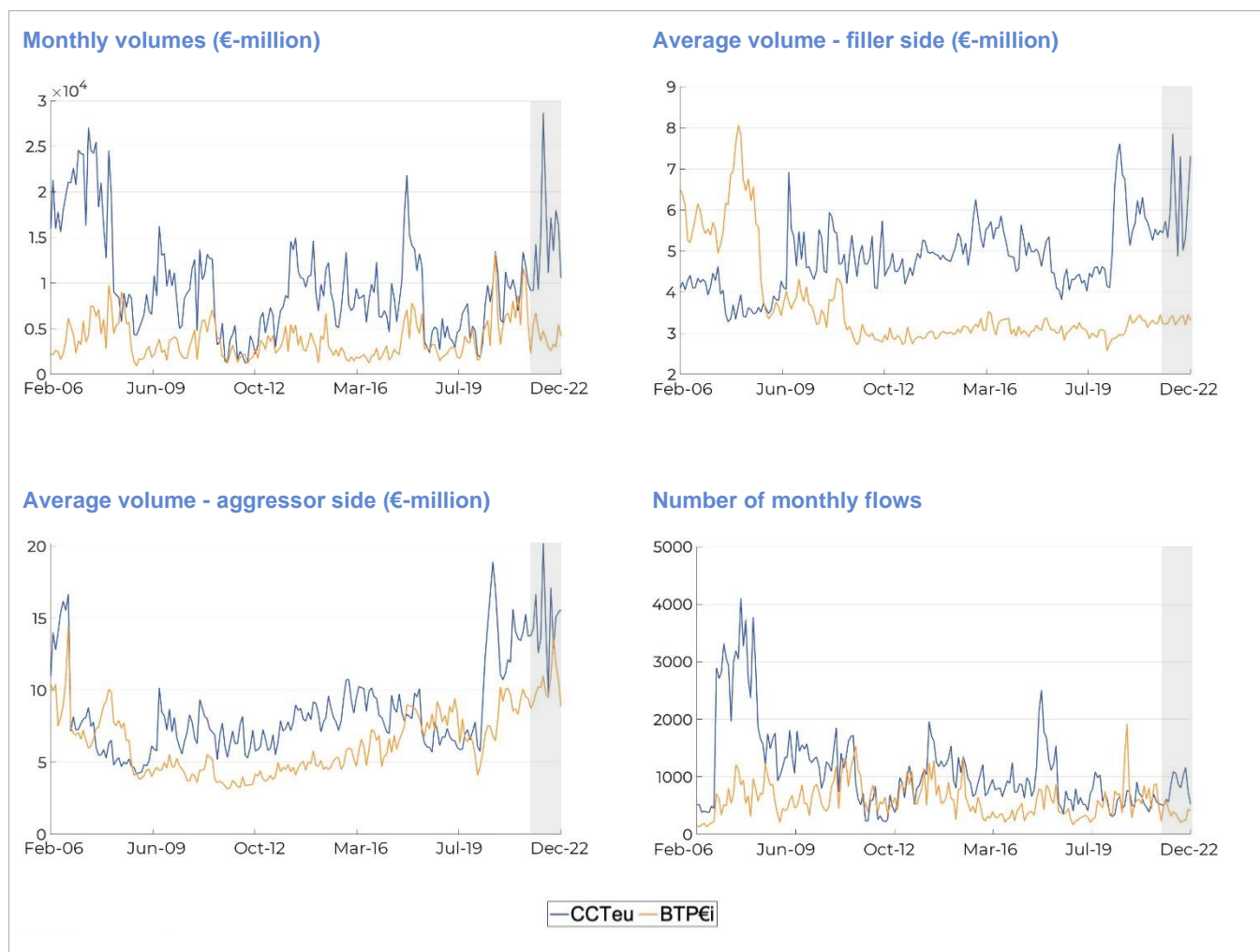
Figure 11: > 10-year BTP



Finally, in the case of the floating-rate segments (CCTeus and BTP€is), two opposite trends emerge (Figure 12). In the case of CCTeus, volumes grow throughout the year, along with an increase in both the number of flows and their average size. On the contrary, the BTP€i segment shows a sharp reduction in the volumes traded on the platform, mostly resulting from a reduction in the number of flows, against a substantial stability in their size. With reference to the market makers' quoting activity on the inflation-indexed bond segment, the reduction in volumes does not appear to be due to changes in the liquidity conditions of the quoting book, which experienced a smoother relative deterioration compared to other segments. On the other hand, it is worth noting that the macroeconomic environment probably interacted with trading activity in the two segments: in a scenario characterised by high and rising inflation, on the one hand, and by concerns about the ECB's monetary policy tightening process, on the other, the latter driver is the only one that allegedly

operated as a driver for trading activity in the two segments, favouring trading in CCTeus. This activity may reflect the greater relative interest of the end-investor community in this segment compared to the linkers, rather than different behaviour of primary dealers, probably as a result of the market participants' expectations of a medium- to long-term inflation. Not surprisingly, the Treasury - as an effect of the interest in the CCTeu segment - issued the new CCTeu 1 October 2030 bond in March for €5 billion through a syndicated transaction.

Figure 12: CCTeu and BTP€i



3.2 The trend in volumes analysed by category of trading flow size

The previous analysis showed a reduction in 2022 compared to the previous year in the volumes traded almost evenly across the various government bond segments. This section investigates on the category of flow size which contributed most to define the volume trend. Specifically, different sizes of flows (defined in the volume category up to €10, 20, 30, 40, 50, 60, 70, 80, 90, 100 million; a category for flows between €100 and €200 million; and finally, a category for flows above €200 million) were distributed (on the aggressor side). For each category, it was examined whether the 2022 figure contributed - and to which extent - to the reduction in volumes by comparing it with the same figure for 2021 (Figure 13).

As for short-dated segments, the reduction in volumes in 2022 compared to 2021 was essentially homogenous across the various categories of flow size for bonds with maturities of up to one year and for 7-year bonds. As regards bonds with intermediate maturities, the analysis shows that the reduction in volumes is related to the lower trading activity of flows up to €100 million, but that there was a net positive contribution in terms of volumes traded for larger flow sizes (the lines show a positive slope for larger categories of flow sizes). In particular, the 3-year bond segment shows an increase in volumes up to €10 million and in flows of at least €90 million in size. This phenomenon seems to suggest that, despite a general reduction in volumes traded and a deterioration in quoting conditions, market participants still have the possibility of trading both small flows and larger flows.

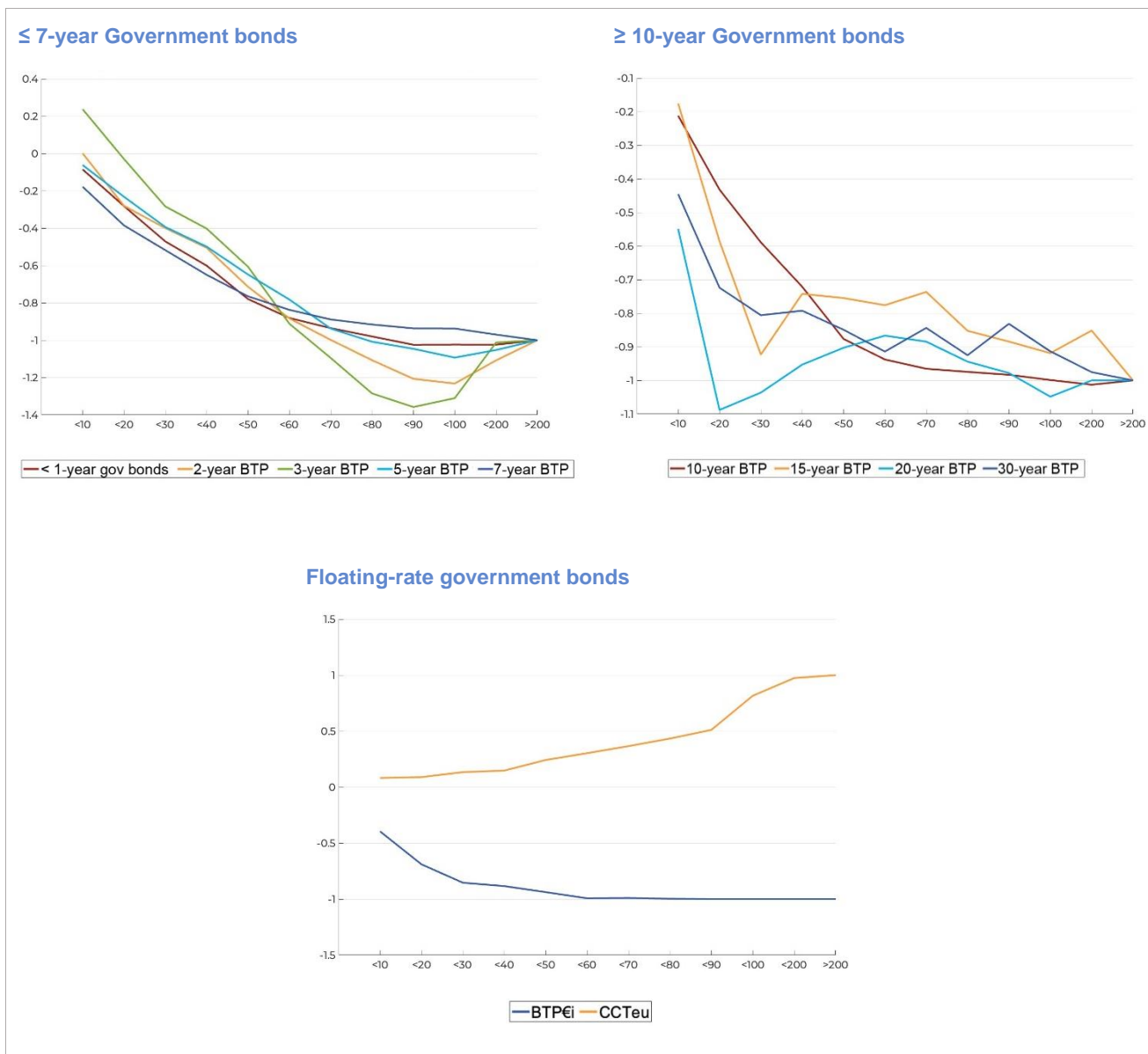
There might be many reasons behind this phenomenon. For instance, an interesting explanation (which may be the subject of future in-depth studies) could be that the worsening of quoting conditions with an increase in flow execution costs may lead to a heterogeneous approach to the trading strategy across flow sizes. The higher cost, on the one hand, might be perceived as bearable for small flows and, on the other hand, might be considered a variable to be disregarded for large flows. In this context, medium-size flows might, on the contrary, be considered by market participants as flows worth executing by paying particular attention to overall market stability and execution costs.

As for bonds with maturity of 10 years or more, the downward trend in volumes is mainly the result of the lower trading activity of small- to medium-sized flows: for the four segments concerned, 80% of the reduction in volumes derives from flows smaller than €40 million. Larger flows, although down compared to the previous year, only partially contribute to the overall reduction in trading activity on these segments.

As far as CCTeUs are concerned, it is worth noting that all categories of flow size contributed to an increase in volumes in 2022 compared to the previous year. However, 50% of the increase relates to the higher trading activity of flows between €90 million and €200 million. This suggests that the uncertain interest rate environment, depending on short- and medium-term monetary policy actions, has generated a growing interest in CCTeU bonds, which has led to an increase in trading activity mostly through the execution of large flows, albeit with rising execution costs (see the section on quoting activity).

Finally, the reduction in volumes on the BTP linker segment is almost entirely related to the reduction in flows of up to €30 million, with figures similar to those seen on the of BTP segments with maturities of 10 years or more.

Figure 13: Analysis by volume categories (2022 vs. 2021)



3.3 The resilience of market makers against medium-sized trading flows and directional fast market phases

This paper has so far analysed the micro-liquidity dynamics by separating quoting activity from trading activity by market participants. The combined analysis of the two different available databases has finally allowed verifying the impact on liquidity measures of the quoting activity of market makers against: i) directional fast market phases; ii) medium-sized trading flows on MTS Italy.

The main sources of literature on the model of financial market microstructures, on which the analysis is based, refer to the implicit costs borne by market makers when providing liquidity to the market (costs arising from information asymmetries⁹ and costs related to inventory management¹⁰). The purpose of this study is therefore to assess the potential effect on market makers' quoting strategies when dealing with sudden changes in market volatility, which can lead to an increase in uncertainty as to the fair value of the quoted financial asset (information asymmetries), and with selling or buying flows, which may both alter the level of inventory held by market makers (inventory management) and change the valuation of the bond's fair value if this flow is believed to be a valuable source of information to assess the fundamental value of the asset traded, assuming that the flow (which remains anonymous for market makers) in itself produces better information about the bond's intrinsic value (again, a problem linked to information asymmetries).

In light of the foregoing, the analysis has been divided in two parts. In the first case, the analysis evaluated how many minutes on average are needed for quoting conditions (evaluated through the various measures of liquidity proposed) to restore the same level of the half-hour prior to a fast market event (identified whenever the market records a variation in the yield to maturity, either positive or negative, of at least 3 basis points in the 5 minutes between two quoting book surveys). In the second case, the analysis tested the impact of a medium-sized trading flow (both buying and selling), i.e., a flow between €15,000 and €45,000 of DV01¹¹. The quoting measures selected in this case are the VWBA spread, the quoted volumes on the best three prices compared to the total quoted volumes and the slope.

Figure 14 shows this analysis for the entire 2006-2022 period for the 10-year BTP segment, for which both databases (quoting and trading) are available, in order to frame the results relating to 2022 in a long-term perspective. Firstly, the analysis of the graphs reveals the validity of this in-depth study in detecting the greater fragility of the quoting conditions offered by market makers during greater market volatility. Indeed, the time series of these measures show peaks of liquidity deterioration (reduction in the resilience of the quoting book structure) in the periods 2012-2013, 2018 and 2020, particularly with reference to the effects of medium-sized trading flows on quoting activity.

As far as 2022 is concerned, after a period of substantial stability at the apparently best possible levels of liquidity conditions offered by market makers (from the second half of 2020 to the end of

⁹ Early and major contributions include: Copeland and Galai (1983), Glosten and Milgrom (1985), Kyle (1985), Easley and O'Hara (1987), Admati and Pfleiderer (1988), Foster and Wiswanathan (1993).

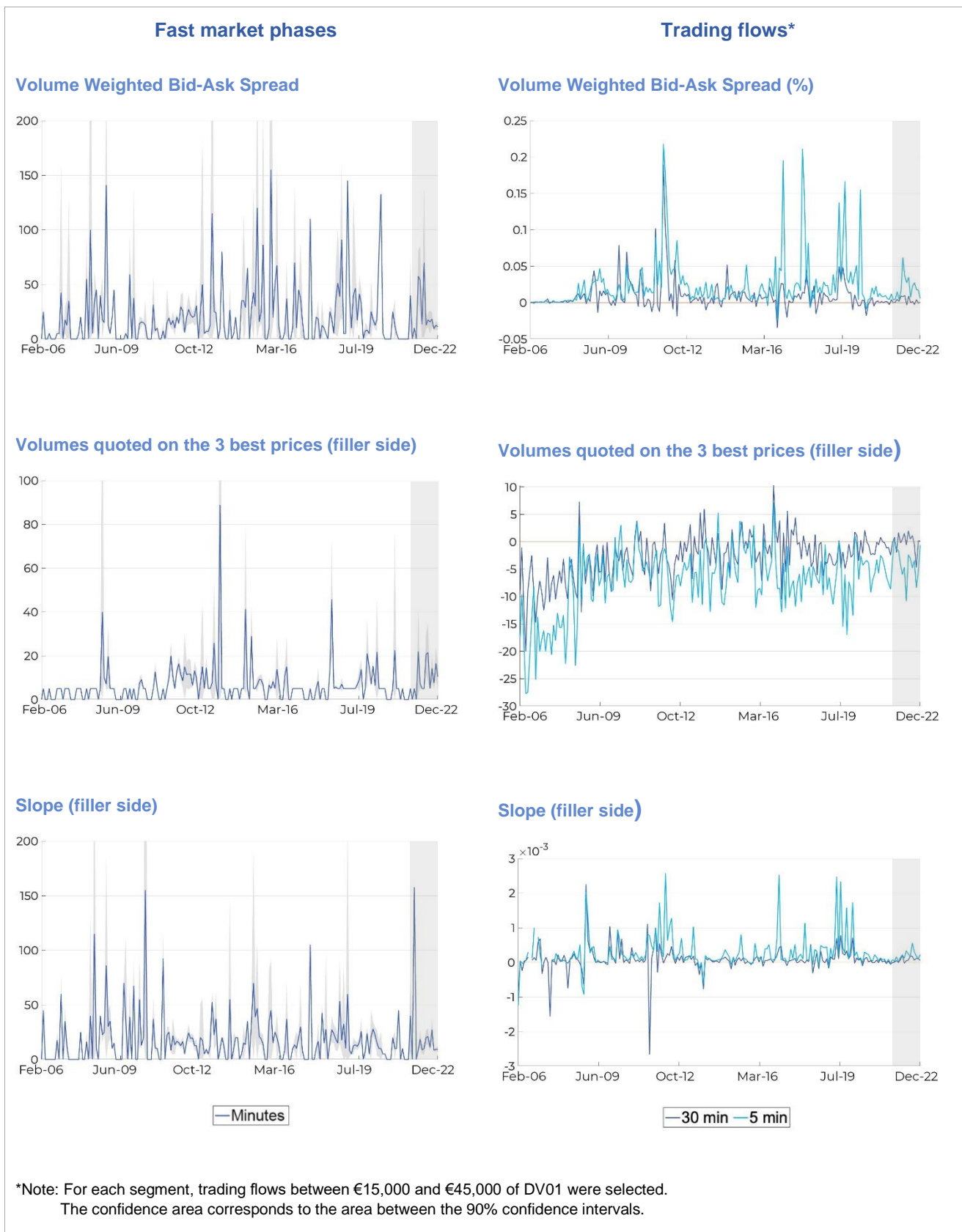
¹⁰ See: Garman (1976), Stoll (1978), Amihud and Mendelson (1980), Ho and Stoll (1981, 1983).

¹¹ Defined as the change in the price of the bond against a 1 basis point change in the yield to maturity.

2021), these metrics show a partial increase in the fragility of quotations: (i) the minutes needed to restore the same liquidity conditions following fast market phases suggest an increasing trend; (ii) the negative effect on quoting measures after 5 minutes from a medium-sized flow is also increasing. However, as analysed the previous sections, 2022 does not seem to be characterised by a general deterioration of market liquidity affecting all market participants:

- I. The negative peak on the slope recorded in December 2021 on the minutes needed to restore the same liquidity conditions prior to fast market phases, not associated with a similar negative peak on the other two measures, suggests that this deterioration is ascribable to the cautious behaviour of primary dealers who were already offering worse conditions;
- II. The deteriorating effect of liquidity after trading flows becomes evident when assessed 5 minutes after the flow; however, the figure taken 30 minutes after the flow does not suggest a negative trend during 2022. In this context, the gradual deterioration recorded from the second half of 2021, for instance in terms of wider bid-ask spreads and less concentrated quoted volumes at the best prices, was not associated with an increase in the volatility of the liquidity conditions offered on the quoting book of the inter-dealer market. In other words, market makers appear to have adjusted their quotations to a level of liquidity offered that they knew they could continue to guarantee even when dealing with trading flows of up to €45,000 of DV01, suggesting the ability of market makers to properly anticipate the equilibrium between the liquidity offered in terms of tight bid-ask spreads and the possibility of having their inventories fluctuate.

Figure 14: Effects on quoting liquidity measures of fast market phases and trading flows – 10-year BTP



Finally, the graphs below show the same analysis for 2022 alone, referring to the quoting VWBA spread and quoted volumes on the three best prices in relation to the total quoted volumes for the 12-month BOT, 10-year BTP and 30-year BTP.

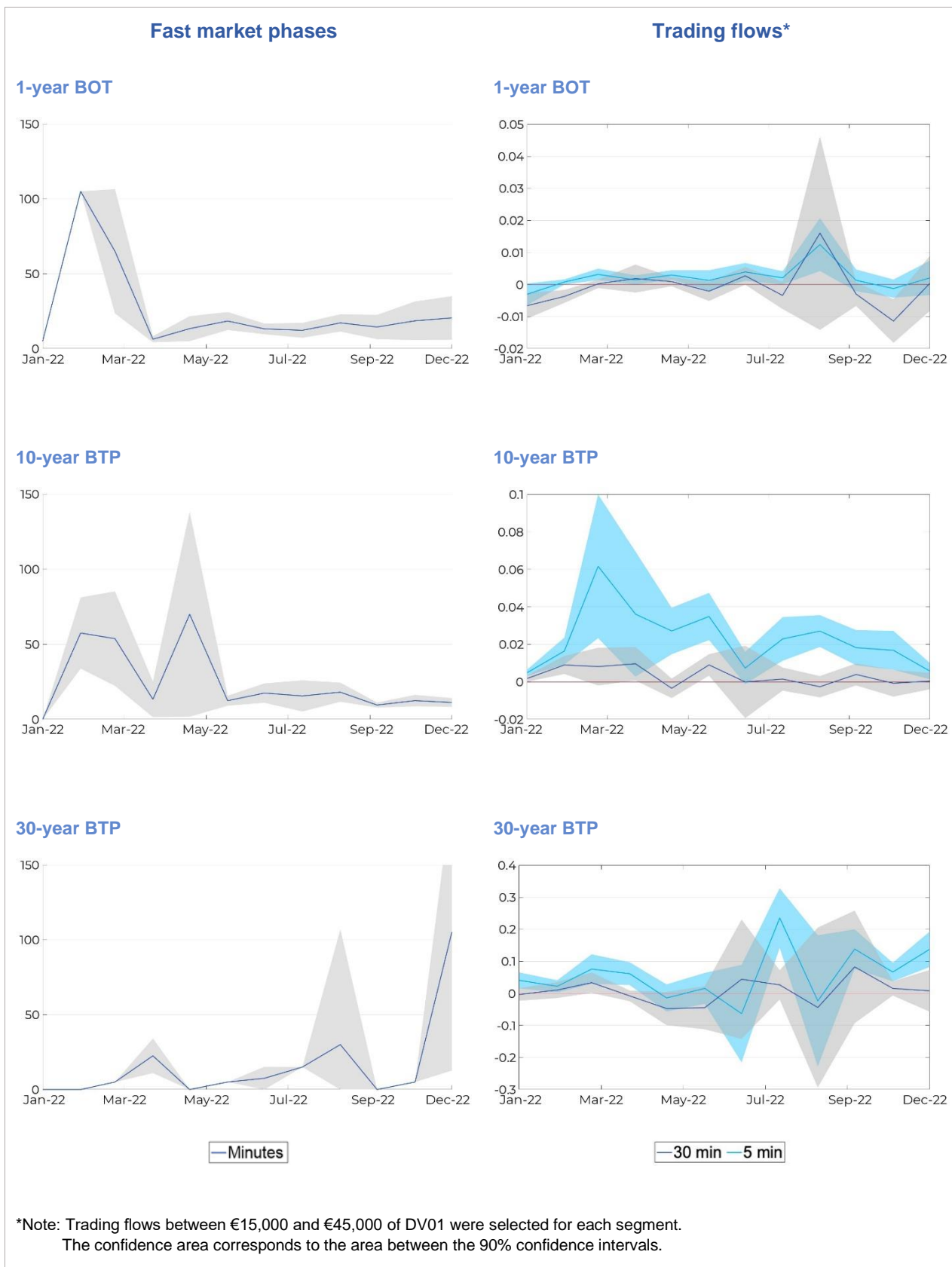
With regard to the VWBA spread (Figure 15), we can identify a diversified effect on liquidity conditions given fast market phases for the three segments:

- I. the 12-month BOT shows the greatest fragility in February, when about 100 minutes were needed for liquidity conditions to return to the same as before a fast market event;
- II. on the 10-year benchmark, the most fragile conditions are found in February, March and May, albeit with peaks found to be lower (in terms of the highest levels recorded) than on the 12-month BOT (in the above months, the negative effect of market volatility disrupted liquidity conditions for about 50 minutes on average);
- III. in the case of the 30-year benchmark, unlike the other two segments, the instability of quoting conditions is most evident in the second half of the year, particularly in August and December (with a monthly average for December of around 100 minutes). Except for these two months, characterised by a less liquid market environment due to holiday periods, the 30-year segment appears to be the one whose quoting activity was least negatively affected by fast market events.

As for the effects of medium-sized trading flows on quoting activity, the analysis reveals a fair alignment for the 10-year and 30-year segments between the above analysis on fast market effects and the 5-minute effects of trading flows: the greater fragility of quoting conditions emerges in the first half of the year in the case of the 10-year BTP and in the second half of the year (especially in August) for the 30-year BTP. Although these two measures are intended to capture different market phenomena, the similar conclusions in identifying the most critical months for quoting activity in the two segments provide a harmonised view in assessing the resilience of market makers during the year.

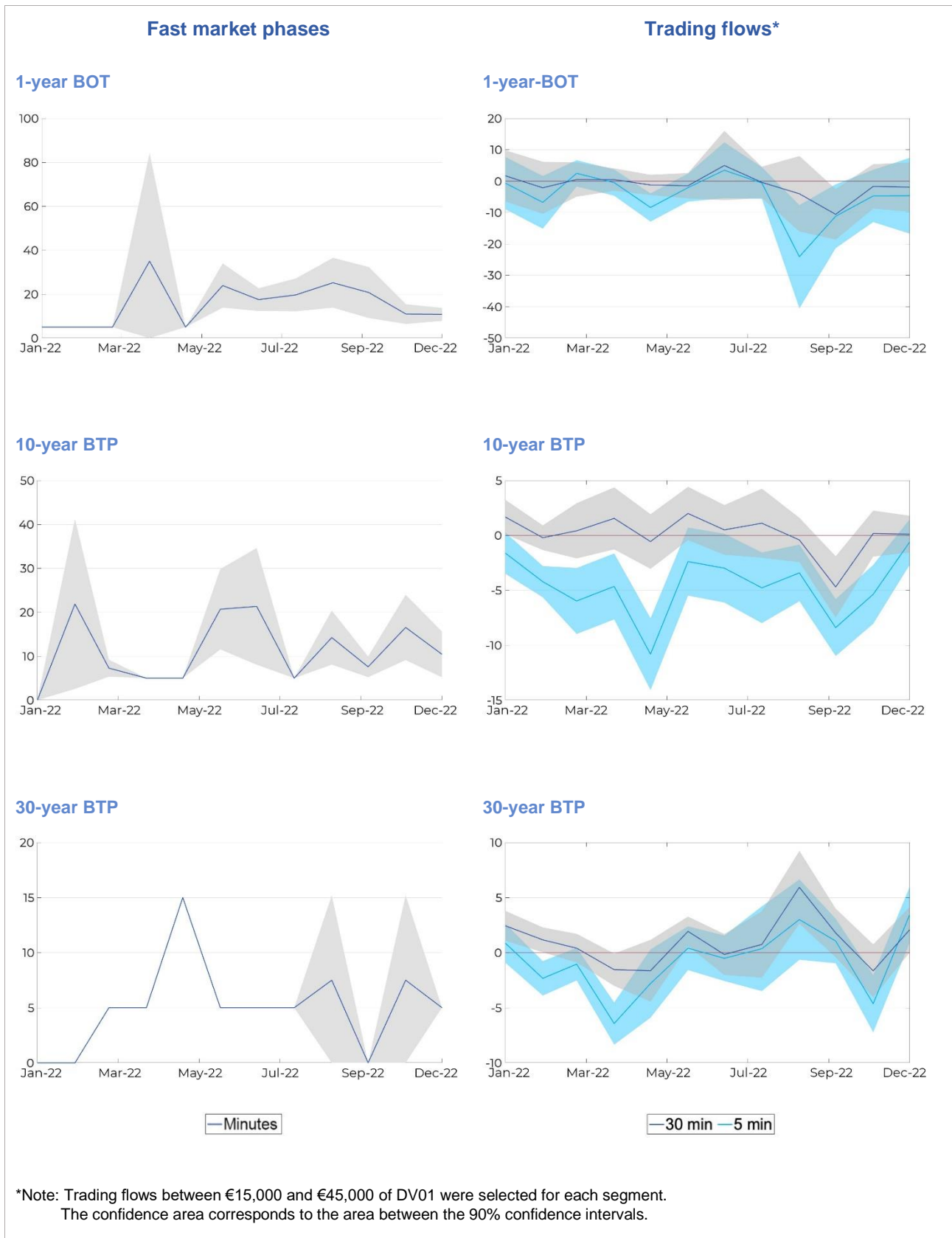
However, it is worth noting that unlike in other periods of stronger market fragility, the effect of medium-sized trading flows on quoting activity is only visible 5 minutes after the flow has been executed, whereas analysis of the effects at 30 minutes seems to show that it almost completely disappears. Thus, the level of quotation instability during 2022 on the three selected segments, while increasing compared to the previous two years, still remains a phenomenon largely limited to the few minutes following the flow - minutes in which market makers need to assess the value of the information of the flow itself, the effect on their inventories in relation to the desired optimal level, but also, to proceed with purely technical and operational steps in order to reactivate their quotations on the inter-dealer market.

Figure 15: Effects on quoting liquidity measures of fast market phases and trading flows - Volume Weighted Bid-Ask Spread (%)



Finally, with regard to the structure of quoted volumes, the measure shows a partially different monthly dynamic (Figure 16) compared to the analysis provided above on the VWBA spread: the negative effect of the fast market phases in the 12-month BOT segment is also found in the second half of the year, as it is for the 10-year BTP; conversely, on the 30-year BTP the negative peak refers to May. This dynamic applied to the volume structure shows, compared to the effects on the VWBA spread, a shorter timeframe for restoring liquidity conditions similar to the phase preceding the fast market event. In this regard, as this measure relates to the behaviour of the most competitive market makers (i.e. those quoting the three best prices), as opposed to the VWBA spread which is affected by the behaviour of all market makers, we can confirm that fast market events generate a diversified effect on the group of market makers: the lower the contribution to the tightness of the quoting book in non-volatile market conditions (wider quoted bid-ask), the greater the negative effect in terms of cautious quoting strategies due to directional and volatile markets.

Figure 16: Effects on quoting liquidity measures of fast market phases and trading flows - Volumes quoted at the 3 best prices (filler side)



4. Algorithmic trading

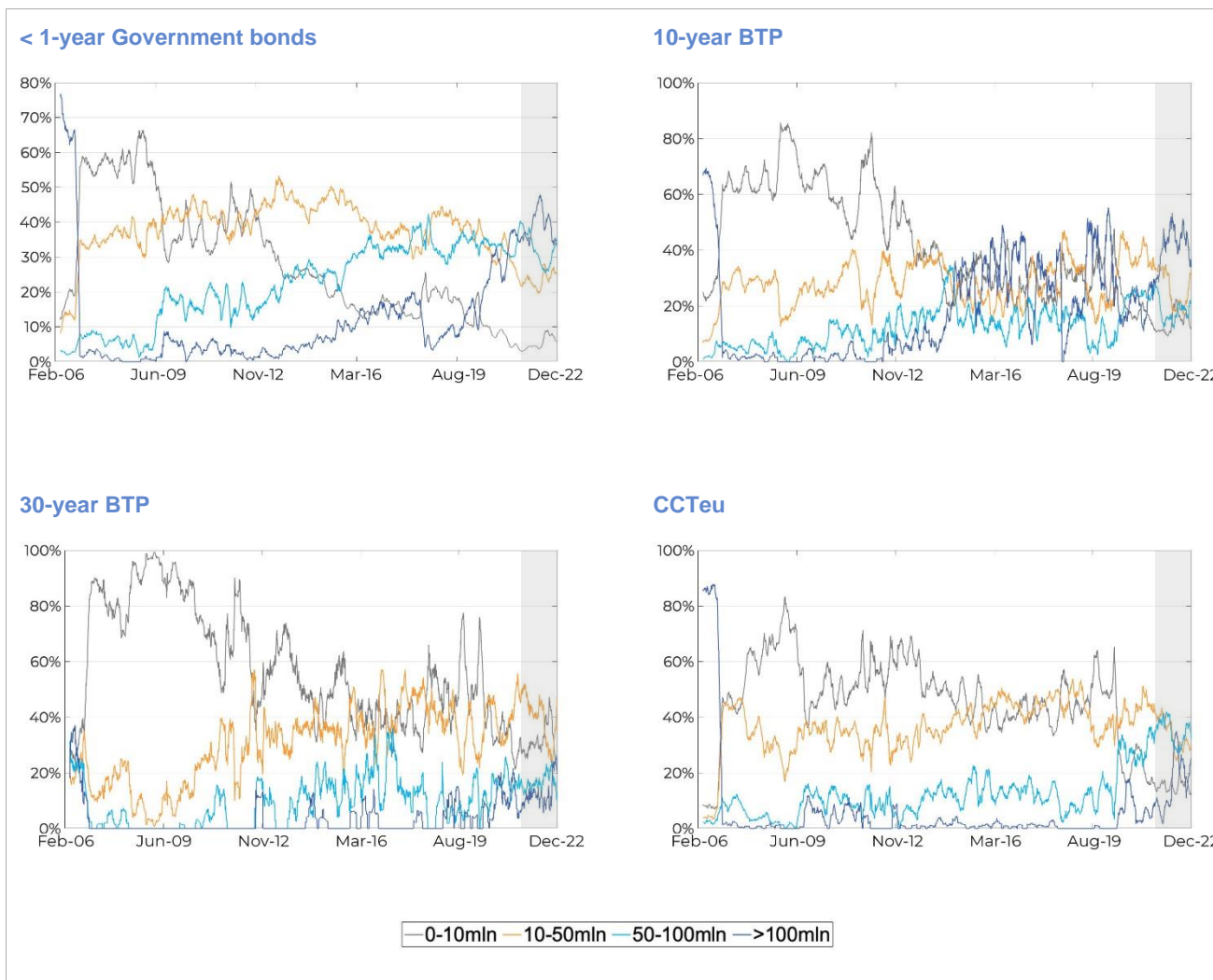
Over the last decade, the activity of market making and, more generally, of financial operators has been characterised by an ever-increasing availability of technological tools capable of making the activity carried out on the markets more efficient and effective. As for market makers, in addition to automated quotation systems, automated trading systems have also become widespread over time. These tools have been developed by banks in order to allow for greater speed, on the one hand, in updating quotations (given the market movements, news and market-mover events, buying and selling flows, etc.) and, on the other, for the execution of orders according to specific algorithms capable of optimising the trading strategy and the time taken to send orders to the market and execute them. In light of these developments, the human action has become increasingly focused on defining and updating quoting and trading strategies according to the trader's preferences in terms of overall portfolio positioning and on individual securities, based on their expectations of market trends.

This section analyses two phenomena closely linked to the technological evolution of recent years: (i) the possibility of making large trading flows by carrying out transactions on multiple securities (typically with close maturities) almost simultaneously, the so-called block or basket trades; (ii) the possibility of adopting auto-hedging strategies, i.e. the strategy through which market makers, following the closure of one or more contracts entered on the quotations offered to the market, instantly enter one or more contracts having opposite sign (buy or sell) in order to minimise the time taken to hedge the risk taken on the previous flow.

As for the execution of block/basket trades, the analysis is divided in two parts: (i) first, analysis of the trend in the daily proportion of large flows (so-called large trades) on the overall traded volumes; (ii) second, analysis of the number of securities involved in the individual executed flows. In both cases, as the size analysed increases, so does the execution risks, typically managed by primary dealers with tools and technological processes developed in recent years.

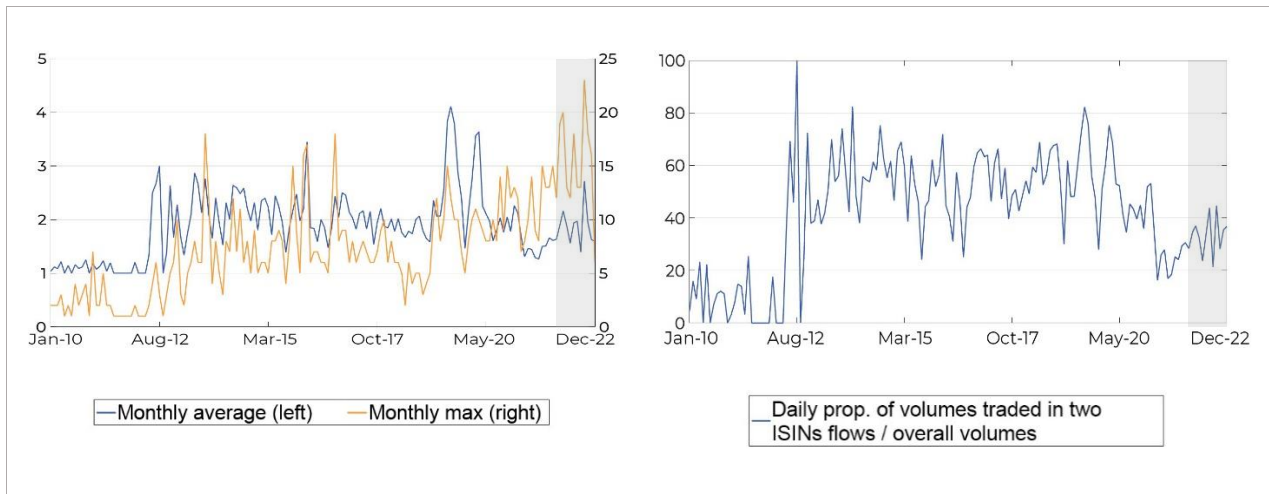
Specifically, with regard to the analysis of the trend in large trades, Figure 17 shows, for each of the selected government bond segments (government bonds with a maturity of less than one year, 10-year BTPs, 30-year BTPs and CCTeus), the 22-day moving average (one calendar month) of the daily proportion of trading volumes executed divided into four categories of size: up to €10 million, from €10 to 50 million, from €50 to 100 million, and above €100 million. The analysis reveals an upward trend in the proportion of daily traded volumes in flows above €100 million almost across all four selected segments.

**Figure 17: Daily share of trading volumes executed in different-sized flows
(%, 22-day average)**



As for flows larger than €100 million only, Figure 18 shows: i) the monthly trend of the average number of securities involved in a single flow; ii) the monthly maximum number of securities involved in a single flow; iii) the monthly average of the daily proportion between the volumes traded in flows involving two or more securities and the total volumes traded. While the average number of securities involved in large flows does not show any particular trend either over the last decade or during 2022, the analysis identifies a clear upward trend in the maximum number of securities involved in a single flow. Specifically, in 2022, flows of at least €100 million were recorded almost every month, in which the aggressor executed this flow on 15 or more securities (in September 2022, an all-time high was reached with 23 securities involved, the annual average being 15 securities). As regards the average daily ratio of flows in which at least two securities are involved out of the total volumes traded in large trades, despite an upward trend compared to the levels of the previous two years, the average figure still remains below the levels recorded in the 2012-2019 period.

Figure 18: Trading flows larger than €100 million on multiple securities (block/basket trades)



It is still worth noting that the execution of orders on multiple securities is also associated with flows smaller than €100 million in size. However, here the analysis aims to highlight the growing trend of volumes traded through flows that generate a greater effect on the market both in terms of the number of securities on which the contracts are executed and the size of the flows themselves, with a direct impact in terms of changes in primary dealers' inventories and reporting for all market participants.

As mentioned above, these dynamics are linked to trading activity presumably performed through algorithmic trading systems capable of executing orders on multiple significant securities at the same time, thus being able to reduce the operational risks of their execution.

Figure 19 shows the proportions of monthly volumes generated by auto-hedging activity out of the total volumes traded on the inter-dealer platform for the various selected segments. The general trend characterising the past two years reveals a steady growth in the volumes generated by such trading strategies across all the segments analysed. During 2022, the various types of securities show a homogenous initial stabilisation of the share of volumes deriving from auto-hedging compared to the levels recorded in 2021, a decrease of this share in the summer months and a final recovery in at the end of the year. This trend is even more evident in the short-dated securities segment than in the other segments. In absolute terms, at the end of 2022, the highest proportion of auto-hedging volumes compared to volumes traded was found to be in the 10-year government bond segment, with a monthly peak in November of over 40%, confirming this area as the one on which liquidity discovery phenomena are most pronounced.

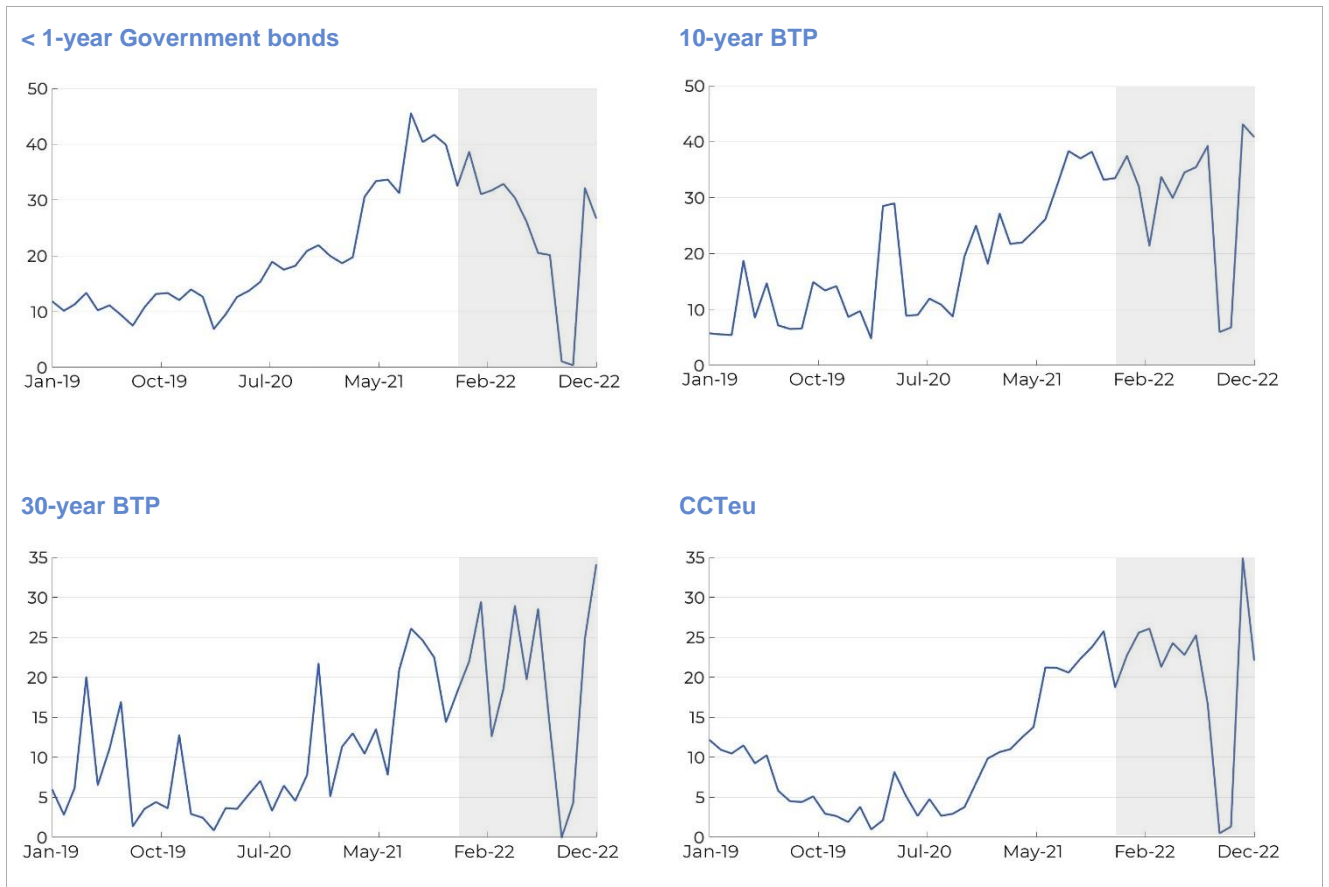
The stabilisation of the growth trend in auto-hedging activity recorded at the beginning of the year and the subsequent sharp decline in the summer months can be attributed to several factors:

- I. the start of a monitoring action by the Treasury communicated to primary dealers changing the criteria for their evaluation in December 2021;
- II. the entry of new Candidate Specialists, where these players used less evolved trading systems and strategies compared to those already used by the specialised banks on the market, especially without the auto-hedging mechanism;
- III. the worsening of liquidity conditions in terms of quoting on the MTS platform (in particular, the widening of the bid-ask spread), which may have led traders to use alternative auto-hedging strategies (e.g., buying and selling futures contracts¹²), with more favourable execution costs;
- IV. internal factors within primary dealer banks such as, but not limited to, internal reorganisations, further technological developments, etc.

Finally, phenomenon contributed to the growth in volumes in 2020 and 2021 discussed in Section 3.1. Indeed, as bid-ask spreads narrowed, the efficiency of auto-hedging on the inter-dealer platform increased, attracting volumes that would otherwise have been conveyed to other instruments or platforms.

¹² The *futures* contract on a basket of ten-year BTPs was introduced by Eurex on 14 September 2009. The instrument, similar to other *futures* contracts with underlying fixed-income bonds of other sovereign issuers yet different in some aspects, was introduced in order to provide market participants with a derivative instrument on 10-year government bonds useful for managing the issuer's credit risk with a significant leverage component. The futures contract is therefore believed to be one of the instruments available to primary dealers in order to manage exposure to Italian sovereign risk (and, not to be excluded, to the credit risk of other high-debt sovereign issuers) in the inventory management activity deriving from market making activity. As for the relationship between the BTP futures market and the wholesale market for Italian government bonds, especially with reference to the relationship between the liquidity conditions in the two markets, see Pelizzon et al. (2014), Panzarino et al. (2016) and the Public Debt Reports of the most recent years published by the MEF, available at https://www.dt.mef.gov.it/debito_pubblico/presentazioni_studi_relazioni/archivio_presentazioni/elem_0008.html.

Figure 19: Monthly auto-hedging volumes as a percentage of total traded volumes (%)



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