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The COVID-19 Auction Premium*

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Abstract

We uncover an additional channel by which a pandemic is costly for taxpayers, namely the surge of the bond auction premium. Using futures and cash data on Italian bonds, we show that the auction premium is correlated with bond price volatility which, in turn, was associated with news about COVID-19 infections and the ECB monetary policy response to the first wave of the pandemic. We quantify the issuance cost for the Italian Treasury at the volatility peak to be 136 bps of the auction size. Our results indicate that subsequent monetary policy measures, implemented since 18 March 2020, effectively reduced volatility, and consequently the size of the premium, during the second wave of the pandemic.

JEL classification: G14, G12, C58;

Keywords: Auction premium, COVID-19, monetary policy, bond markets.

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1 Introduction

The impact of the COVID-19 pandemic on economic activity is still to be fully understood. This paper studies the effects of the pandemic on a central tool for government budgeting: Treasury auctions. We focus on Italy, the country with the largest public debt of the Eurozone, and uncover an additional cost for taxpayers directly caused by the advent of the pandemic: the surge of the auction premium, that is the drop in prices (or, equivalently, the rise in yields) of bonds at their auction time. We estimate that, at the peak of the first wave, the premium paid by the Italian Treasury to primary dealers was 136 bps of the amount offered, at least 50 million euros according to our conservative estimate. The registered premium was much larger than the premium previously documented by the existing literature (below 20 bps), and it was all concentrated on a very special day, that is 12 March 2020. Consistent with the economic theory of the auction cycle, the high premium can be associated with abnormal volatility (more than 60% yearly, a shockingly high value for bonds), which in this case can be explicitly associated with the pandemic outbreak. We also argue that the European Central Bank (ECB) response to the pandemic crisis, starting with the Pandemic Emergency Purchase Programme (PEPP) program announced on 18 March 2020, was effective in reducing the secondary bond market volatility and, as a consequence, the size of the auction premium registered during the following auctions.

The impact of COVID-19 on the efficiency of the bond market has been intensely scrutinized for the U.S. Treasury market. The crisis was peculiar there since, in contrast to previous periods of financial market turmoil, the prices of long-term U.S. Treasuries sharply declined. Duffie (2020) questions the safe-haven status of such assets, advocating the reform of the design of the U.S. Treasury market. To improve financial stability, he advocates the introduction of a broad central clearing mandate. He et al. (2020) argue that the sharp fall of U.S. Treasury prices was due to balance sheet constraints of dealers, and build a model to show how a negative demand shock for U.S. Treasuries can affect the term structure of Treasury yields. Schrimpf et al. (2020) point at hedge funds as a major amplifier of the events in the U.S. Treasury market. In contrast, Di Maggio (2020) argues that their positions were too small to be the main cause of the disruptions. We contribute to this literature by focusing on the Italian sovereign bond market, the largest in the European Union (International Capital Market Association, May 2020). Although, in general, Italian sovereign bond prices also sharply declined in 2020, our interest is in the even sharper price decline, which we prove to be far from the fundamental value, observed at Treasury auctions during the first wave of the COVID-19 pandemic.

The behavior of bond prices before and after sovereign bond auctions, the so-called "auction cycle" has also been intensely scrutinized. Lou et al. (2013) document an average rise between 2 and

3 bps on U.S. bond yields in the five days before the auction. They explain the transient bond price decrease by the limited risk-bearing capacity of primary dealers. Sigaux (2020) shows a similar effect for European bond auctions, and in particular he estimates a 2.4 bps yield increase for Italian bonds after private meetings between the Italian Treasury and primary dealers, and after the announcement of the auction size. Bellia (2020), which uses high-frequency data as we do, reports a yield increase in the two hours before the auction between 1 and 2 bps for Italian bonds, and less than 0.5 bps for German bonds in the 2011-2016 post-crisis period. Beetsma et al. (2016) and Beetsma et al. (2018b) also document rising yields in the week before the auction and declining yields in the week after, a phenomenon magnified (up to 6 bps) by the financial crisis of 2007-2009. They also explain the effect with the increased risk aversion of primary dealers. Beetsma et al. (2018a) show that a successful auction is also correlated with a stronger decline of the yield after the auction. Our average auction premium estimate is in line with these numbers. We indeed calculate an average yield increase of 2.96 bps in the two hours before the auctions of a specific 10-year fixed-rate note (BTP) which was repeatedly auctioned. However, we differ from the quoted literature in several aspects. First, we show that the average premium is virtually driven by a single day, that is 12 March 2020, when the yield increase was 13.56 bps (in the remaining days, the average yield increase drops to 1.19 bps). Second, while we show, as in Beetsma et al. (2016), that the premium is related to the volatility of the auctioned bond, we also show in a clear-cut way that excess volatility was associated with news about the COVID-19 first wave as well as with the uncertainty about ECB monetary policy response to the pandemic. We model these effects with a classical model borrowed from the realized volatility literature (Corsi, 2009), enriched with data related to the number of COVID-19 hospitalizations and an ECB meeting dummy. Model estimates on liquid BTP Futures high-frequency data unveil a significantly positive effect of both COVID-19 news and monetary policy meetings on the realized volatility of the bond market. Third, instead of using averages across auctions (a strategy that can provide significant estimates only on large samples, and thus would be ineffective to study the impact of COVID-19 on auctions), we test the presence of the auction premium on individual auctions using the new methodology introduced by Flora and Renò (2020). Using this technique, we can prove that only the auction cycle on 12 March 2020 was statistically significant, and we estimate (using secondary market data on all bonds auctioned on that day) an issuance cost for the Italian Treasury of 136 bps of the total amount offered on that day. To understand the severe impact of the pandemic, we can compare it to the average issuance costs documented by Lou et al. (2013) on the U.S. bond market, which were between 9.07 and 18.43 bps of the offered size. We finally show that the second wave was less impactful both in terms of volatility and size of the auction premium. We interpret this result as a signature of the new ECB monetary policy in

reaction to the pandemic.

The rest of the paper is organized as follows. Section 2 describes the high-frequency data set at our disposal. Section 3 contains our empirical analysis, whose policy implications are discussed in Section 4. Section 5 concludes.

2 Data

Our analysis is based on futures and cash Italian bond data, sampled at high frequency. Futures data consist of prices of the 10-year BTP Futures (the BTP being the Italian fixed-rate note) in the years 2019 and 2020. Prices are sampled at 1-minute frequency in the interval 8:00-19:00 CET. We only use the nearest maturity contract, which is by far the most liquid. We exclude expiry days since the calculation of volatility in these days is impaired by the price change due to the roll-over. The 10-year BTP Futures is an excellent proxy for the cash market, see e.g. Panzarino et al. (2016), especially for calculating daily volatility. We use this dataset to calculate the average auction premium, to assess the impact of COVID-19 news and ECB monetary policy on the 10-year BTP volatility, and to document the correlation between the BTP volatility and the auction premium size.

Cash data consist of all transactions (up to 31 October 2020) of the 7-year, 10-year, 20-year BTPs auctioned on 12 March 2020. In particular we focus on the fixed-rate BTP that was incepted on 30 August 2019 (date of the first tranche issued), namely the "Btp Tf 1,35% Ap30 Eur" with ISIN IT0005383309. After the first issuance, this note was auctioned in 7 additional ordinary tranches in 2019 (on 27 September, 30 October, 28 November and 30 December) and in 2020 (on 30 January, 12 March and 31 March). We use all the transactions in the Monte Titoli (MOT) market as provided by Borsa Italiana S.p.A.. MOT is the main retail trading venue by volume for Italian government bonds, processing 11.0% of all trades on platforms in 2019 and 8.5% in the first two quarters of 2020 (see CONSOB, 2020), and is characterized by a large number of transactions with small size. Despite its relatively thin volume, the high number of transactions in the MOT provides more granularity than the BTP Futures to study the statistical significance of the auction premium on individual auctions. Moreover, in this market, absence of cross-market arbitrage and fair and accurate security pricing is broadly guaranteed within the bid-ask spreads (Schneider and Lillo, 2019). Thus we also use directly the MOT data to estimate Italian Treasury issuance costs. The calendar of auctions on BTPs is taken from the website of the Bank of Italy.

Daily COVID-19 data for Italy come from the website of the European Centre for Disease Protection and Control (ECDC), which is an agency of the European Union. The dataset counts started

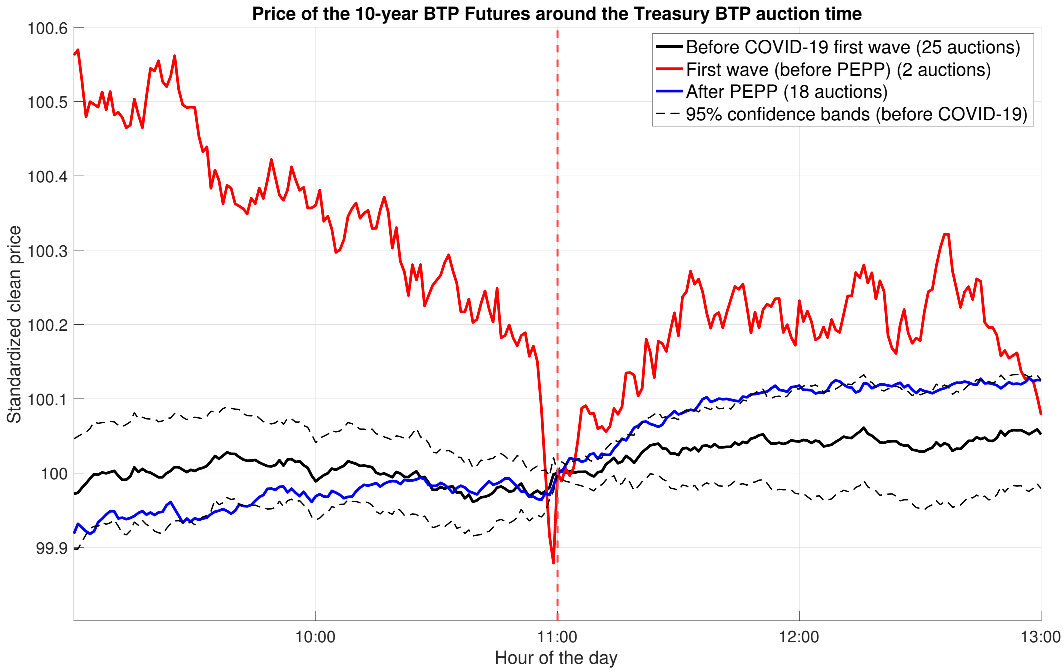

Figure 1: Average (standardized) intraday prices of the 10-year BTP futures on BTP Treasury auction days, in three different periods. Before COVID-19 first wave: from 1 Jan 2019 to 22 Feb 2020; First wave (before PEPP): from 23 Feb 2020 to 17 Mar 2020; After PEPP: from 18 Mar 2020 to 31 Dec 2020. The time at which Treasury auctions end is 11:00 CET. Prices are sampled every minute.

on 23 February 2020.

3 Auction premium during the COVID-19 pandemic

Figure 1 shows averages of intraday clean prices of the 10-year BTP Futures, between 9:00 and 13:00[1] on days in which a Treasury auction on BTPs (fixed rate sovereign bonds) takes place. Prices are standardized at the value 100 at 11:00, the time at which the Treasury auctions are concluded in Italy. We average prices in three different periods. The first one is the pre-COVID-19 period, running from the beginning of the futures sample (1 January 2019), to the day before the first hospitalizations due to COVID-19 were reported (23 February 2020). In total, 25 auctions were held in this period. The second period goes from 23 February 2020 to the day before 18 March 2020, the day in which the ECB launched the PEPP program (see the discussion in Section 4.2). Two auctions were held in this turbulent time window, on 27 February and 12 March 2020. Figure 2 shows the price of the 10-year BTP Futures in these two auctions. The third period goes from 18 March 2020 to the end of our sample (31 December 2020), and consists of 18 auctions. In the auctions held by the Italian Treasury, primary dealers can submit their bids until 11:00,

[1]All times in this paper are CET.

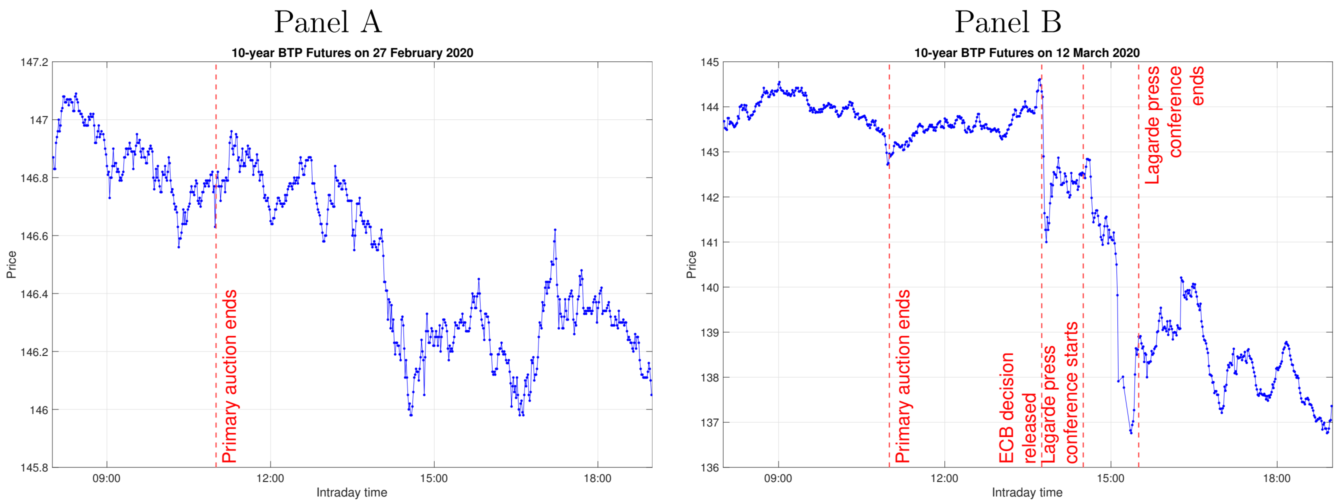

Figure 2: Intraday prices of the 10-year BTP futures on 27 February 2020 (Panel A) and 12 March 2020 (Panel B). Prices are sampled every minute.

and typically most of the bids come at the very last minute. The figure shows a clear auction cycle in the two auctions during the outbreak of the first wave, which is strongly significant with respect to the average price fluctuations on auction days before COVID (a formal test of market inefficiency during the auctions will be performed in Section 3.1). Figure 2 also shows that, after the launch of the PEPP, things were "back to normal", with a slight sign of an average rise of the price after the end of the auctions.

The auction premium was then particularly pronounced in the auction of 12 March. That day was particularly dramatic since a new package of monetary policy measures was announced by the ECB at 13:45. These measures included additional long term refinancing operations, a reduction in the interest charged for such operations, and an increase in asset purchases. Markets reacted negatively to the package (as shown in panel B of Figure 2) because participants had been expecting a rate cut of at least 10 bps as a way to stimulate the euro economy, but that did not materialize.[2] In addition, markets appeared to also be spooked by some of the answers of the ECB President to questions asked during the press conference that started at 14:30.[3]

Why was the auction cycle so pronounced on that day? The presence of an auction cycle has been rationalized by economic theory. Lou et al. (2013) explain the transient price decrease with the limited risk-bearing capacity of primary dealers. Their theory has two ingredients: the supply shock at the auction is repeated and anticipated, and primary dealers are expected to submit bids. As part of the first ingredient, primary dealers hedge the supply shock by selling substitute bonds in the secondary market before the auctions, which creates a temporary downward pressure

[2]See, e.g., `https://www.ft.com/content/48ccc8e0-6414-11ea-b3f3-fe4680ea68b5/`.

[3]See, e.g., `https://ftalphaville.ft.com/2020/03/12/1584027114000/A-dangerous-slip-up-from-Lagarde/`.

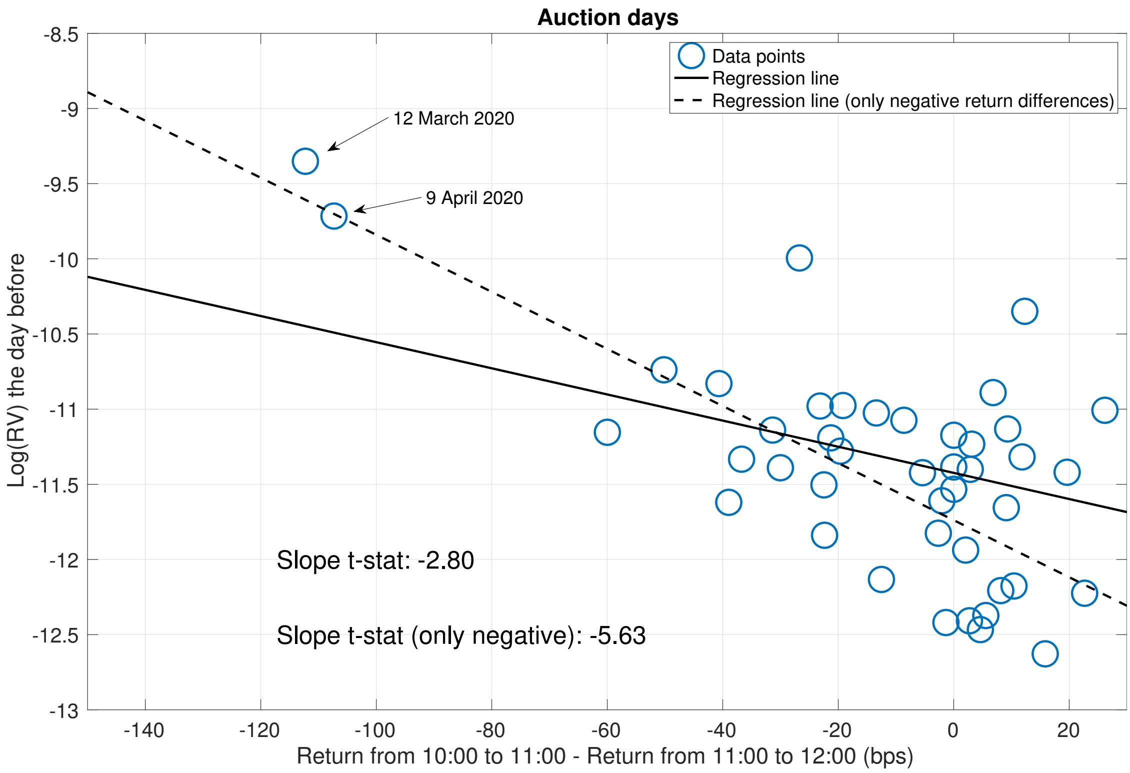

Figure 3: The difference between hourly returns before and after the auction (an estimate of the auction cycle) versus the logarithm of 5-minute Realized Variance computed on the previous day.

in prices. The second ingredient is that this pressure is not absorbed by arbitrageurs because of liquidity constraints, thus leading to a temporary price inefficiency. A prediction of this model is that higher volatility should magnify the effect because of the risk aversion of the primary dealers. Thus, a testable empirical implication is that bond price volatility should be correlated with the auction premium.

We exploit the availability of high-frequency data to estimate precisely the BTP Futures volatility and its relation with the auction cycle. Volatility is estimated by daily realized variance, that is the sum of intraday squared 5-minute returns from 8:00 to 18:00. To estimate the size of the auction cycle, we use the following convexity measure:

$$\mathcal{C}^i = \left(\log p^i_{t_2} - \log p^i_{t_1}\right) - \left(\log p^i_{t_3} - \log p^i_{t_2}\right), \tag{3.1}$$

where $i = 1, \ldots, 45$ denotes the Treasury auction day, p^i_t is the BTP futures price on day i at intraday time t, and t_1 =10:00, t_2 =11:00, t_3 =12:00. Thus, $\mathcal{C}^i$ is the difference between the logarithmic return between 10:00 and 11:00 and the logarithmic return between 11:00 and 12:00. In the presence of an auction cycle, $\mathcal{C}^i$ should be negative. Figure 3 shows the relation between (logarithmic) volatility on the day before the auction and the size of the auction cycle on the

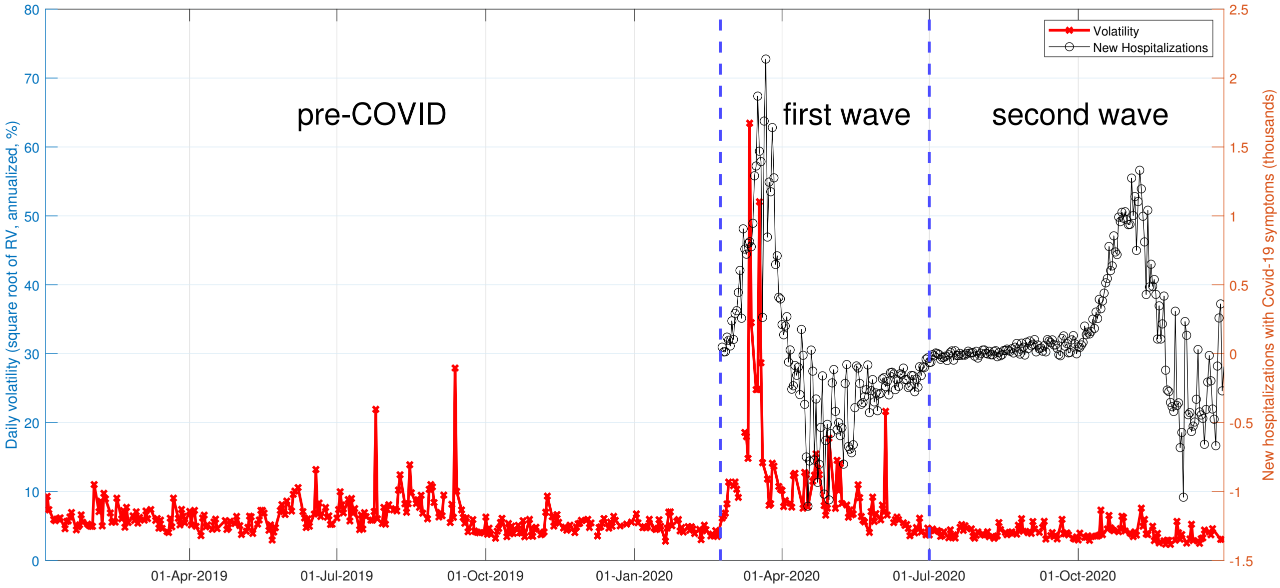

Figure 4: Daily realized volatility of the 10-year BTP Futures, measured as the square root of 5-minute realized volatility, and number of new hospitalizations with Covid-19 symptoms.

auction day. We use the previous day to avoid the potential mechanical correlation between the auction cycle and contemporaneous volatility. In our two-year sample, we have 45 BTP auctions.

Figure 3 shows two important results. First, the estimated regression lines between $\mathcal{C}_i$ and the previous day logarithmic realized volatility are consistent with the predicted limited risk-bearing capacity of primary dealers. Indeed, the slope of the regression with all auction data is negative and significant. If we exclude days with positive $\mathcal{C}_i$, the slope is even more negative and significant. Thus, we conclude that the observed auction premium is consistent with extremely volatile prices. We notice that 12 March 2020 was the day with the highest $\mathcal{C}_i$ in our sample, that is the day with the deepest auction cycle.

Was the COVID-19 pandemic the source of the heightened volatility which, in turn, can be associated with a larger auction premium? To provide an answer to this question, we use a fully-blown statistical model for realized volatility dynamics in which we control for volatility persistence, COVID-19 news and monetary policy uncertainty.

Figure 4 shows the daily volatility of the 10-year BTP Futures as measured, again, by the square root of 5-minute realized volatility (from 8:00 to 19:00). Figure 4 also shows the number of new hospitalizations with COVID-19 symptoms in Italy, as reported by ECDC. Before the pandemic starts, daily volatility hovers around the 6-7% range (annualized), a typical figure for the 10-year Treasury bond. As the pandemic starts spreading and the first wave of infections unfolds, volatility surges in unison with new hospitalizations, up to a stunning 63.46% on 12 March 2020, the day when volatility reached its maximum level. As discussed, 12 March 2020 was also a day in which

	Pre-Covid (1 Jan 2019-22 Feb 2020)		First wave (23 Feb 2020-30 Jun 2020)		Second wave (1 Jul 2020-31 Dec 2020)	
Constant	0.91	1.48	4.94***	3.26	2.92***	3.91
$\sqrt{RV}_{t-1}$	0.16**	2.50	0.44***	5.15	0.18*	1.77
$\sqrt{RV}_{t-1:t-5}$	0.30**	2.31	0.02	0.15	0.05	0.28
$\sqrt{RV}_{t-1:t-22}$	0.36**	2.44	−0.03	−0.26	0.00	0.03
ECB meetings	5.96***	7.94	26.50***	11.09	1.18***	2.61
COVID_{t-1}	–	–	2.72**	2.44	0.65***	2.71
Observations	285		86		128	
R^2	33.84		75.52		16.70	

Table 1: Estimation results of model (3.2) in the three periods displayed in Figure 4.

uncertainty about the ECB response to the pandemic hit the market deeply. To account for the joint presence of these effects, we use a modification of the celebrated HAR model of Corsi (2009) and we assume that the daily volatility dynamics follow

$$\sqrt{RV_t} = \alpha + \beta_d \sqrt{RV}_{t-1} + \beta_w \sqrt{RV}_{t-1:t-5} + \beta_m \sqrt{RV}_{t-1:t-22} + \gamma \text{COVID}_{t-1} + \delta \text{ECB}_t + \varepsilon_t, \quad (3.2)$$

where RV_t is the realized volatility on day t, $\sqrt{RV}_{t-1:t-5}$ and $\sqrt{RV}_{t-1:t-22}$ are the averages of $\sqrt{RV_t}$ in the previous 5 and 22 days respectively, COVID_t is the number of new hospitalizations with Covid-19 symptoms (in thousands)[4], ECB_t is a dummy that takes the value 1 on days in which ECB releases a new monetary decision, and 0 otherwise, and ε_t is iid zero-mean noise with finite variance. The first three explanatory variables ($\sqrt{RV}_{t-1}$, $\sqrt{RV}_{t-1:t-5}$ and $\sqrt{RV}_{t-1:t-22}$) are meant to model the "normal" volatility dynamics and its short and long term persistence. The COVID_{t-1} term captures the news about the spreading of the coronavirus. The ECB_t dummy reflects the uncertainty in bond pricing on days in which monetary decisions are released, which were all pre-scheduled in our sample with the exception of 18 March 2020, the day in which the PEPP program was launched.

We estimate model (3.2) in the three periods indicated in Figure 4 and display parameter estimates in Table 1. In the "normal" pre-COVID period all three coefficients β_d, β_w and β_m measuring volatility persistence are significant, which is a common finding in the HAR framework. Moreover, the uncertainty about monetary policy, captured by the dummy on the days of ECB policy meetings generates additional volatility for the 10-year bonds. On average, daily volatility increases by 5.96% in ECB meeting days, and the effect is strongly statistically significant.

[4] To check for robustness, we used alternative variables like the number of new cases, the number of new positive testings, the number of new hospitalizations in intensive therapy and the ratio between positive and total number of tests. In all these cases, results are broadly in line with the proposed analysis.

During the first wave, only the daily persistence component β_d is significant, which is a typical signal of short-term dependence, and thus of turmoil. Most importantly, the ECB monetary decision dummy has a stronger and more significant impact on the volatility of Treasury bonds in this period with respect to the "normal period", with an average volatility increase of 26.50% in annualized terms in ECB meeting days, and strong statistical significance. During the first wave, the model also implies 2.72% more volatility for each $1,000$ new hospitalizations, the coefficient being mildly statistically significant. This implies that the additional uncertainty due to the COVID-19 pandemic was not only concentrated on days when monetary decisions had to be announced, but also built up on a day-to-day basis as the market gathered more information about the evolution of the pandemic. Given the large number of hospitalizations during the first wave, this had the cumulative impact on total volatility that is visible in Figure 4.

During the second wave, volatility persistence drastically decreases with none of the auto-regressive coefficients being significant at 5%. The uncertainty associated with ECB monetary policy also drastically lowers, and almost disappears, during the second wave, as signaled by the ECB meetings dummy coefficient being small (1.18%), albeit still mildly significant. The impact of new hospitalizations due to the pandemic is still significant but strongly declines, from 2.72% (per $1,000$ hospitalizations) to 0.65%. As a result, volatility during this period is practically flat.

The key takeaway from the estimated results of the regression model (3.2) is that the spreading of the COVID-19 pandemic had a significant impact on the 10-year BTP futures volatility. This was conveyed by two channels: a direct relation between new COVID-19 cases and bond volatility, and an indirect one through monetary decisions in response to the pandemic. A key driver of bond volatility was ECB meetings, and there is little doubt that their impact was magnified (from 5.96% to 26.50%) by the pandemic. The two days with largest volatility in our sample were indeed 12 March 2020, as already discussed, and 18 March 2020 (volatility: 52.06%), the day when the ECB Governing Council announced the 750 billion euro Pandemic Emergency Purchase Programme (PEPP). As mentioned, according to the theory in Lou et al. (2013), we expect this heightened volatility of the Treasury bond market to generate a larger auction premium. Figure 1 shows the size of that premium. The next section assesses its statistical significance.

3.1 Statistical significance of the auction premium

This section shows that the auction premium observed in the secondary sovereign bond market was a market anomaly in which the price deviated from fundamental values. Since the premium is concentrated in a few auctions (and, more prominently, on the auction of 12 March 2020) we cannot reliably use sample averages, as typically done in the auction premium literature (see, e.g., Lou et al., 2013; Beetsma et al., 2016; Bellia, 2020). To test the significance of market inefficiency during individual auctions, we resort to the V-statistic of Flora and Renò (2020). Intuitively, the V-statistic is the product of the signed "strength" of the price trend relative to price volatility. The trend is estimated via the drift burst statistic (Christensen et al., 2020) computed right before and after a given time-point. Negative values of the V-statistic imply a downward move immediately followed by an upward move or vice versa, that is a significant V-shape in prices, typically observed when prices move away from fundamentals and then retrace back. The V-statistic can thus test for market inefficiency in the Fama (1970) sense. A positive value of the V-statistic instead signals a large directional trend before and after the testing point. This technique is perfectly suited for event studies, where in our case the event is the advent of the COVID-19 pandemic. The V-shape we want to test is the (inefficient) price fluctuation due to the auction cycle.

To implement the V-statistic, we use exponential kernels as in Flora and Renò (2020) and three different bandwidth parameters, that measure the extent of the localization of the test. Statistical significance of the test is assessed using parametric bootstrap. The bootstrap model is chosen to filter the volatility of the log-price under the assumption of absence of significant price trends. We use an EGARCH(1,1) (with zero return mean) model to filter the intraday volatility. The p-value of the aggregated statistics (we use the minimum of $\mathcal{V}_{\tau,n}$ computed over several points) can then be easily estimated on simulations obtained with a stochastic volatility model with volatility as filtered by the EGARCH(1,1).

We implement the test on spot data of the 10-year BTP auctioned during the first wave. As discussed in Section 2, this has two advantages with respect to using the BTP Futures. First, we test the anomaly directly on the instrument that is supplied by the auctions and that the primary dealers need to hedge. Second, using all transactions (instead of 1-minute data) greatly improves the resolution of the test statistics. As described in Section 2, the 10-year BTP was auctioned 7 times in our sample. Figure 5 shows the intraday prices of the 10-year BTP, between 9:00 and 13:00 on the seven days it was auctioned. The auction cycle on 12 March 2020 is again clearly visible, showing that there were no market fragmentation between the cash and the futures market even during that extraordinary circumstance. An auction cycle is also slightly visible on 20 March, while it is much less pronounced in the other five auctions. The average yield increase between 9:00 and 11:00 is 2.96 bps, in line with estimates of the auction premium reported in the existing literature.

Table 2 shows the minimum of the V-statistic, its p-value and the time when the minimum is reached during all auction days. We compute the test with three different bandwidths at each transaction time in the 30 minutes around the auction end time (11:00). The results clearly show

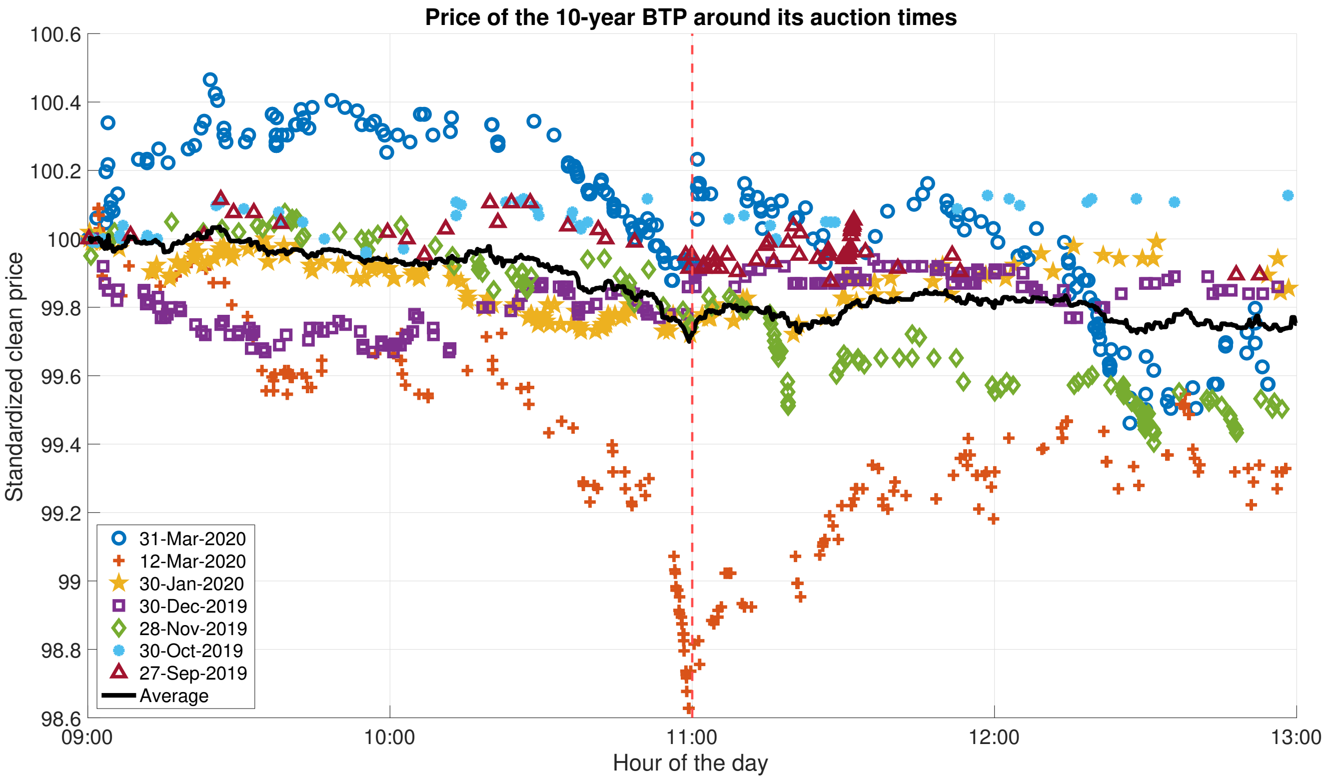

Figure 5: Intraday prices of the 10-year BTP on the days when it was auctioned, as reported by the legend, around the auction time (at 11:00). Prices are from transactions in the MOT market.

that only the V-shape of 12 March 2020 was statistically significant (and largely so). In the other days, we cannot reject the null of a random fluctuation of an efficient price.

We thus focus on the very special day of 12 March 2020. Figure 6 reports the values of the V-statistic for three bandwidths: 5, 15, and 30 minutes. Reported confidence bands are for point-wise estimates with the 15 minute bandwidth, while p-values in Table 2 are for the minimum of the V-statistics between 10:45 and 11:15, and are thus robust to multiple testing. Figure 6 shows three main time-points when the V-statistic takes significantly large values. The first one is exactly at 11:00, when the V-statistics take strongly negative values for all three bandwidths considered (more prominently, for the 15-minute one). Table 2 shows that these negative values are largely significant also after accounting for multiple testing. The second one is around 13:45, slightly before (more prominently, for the 15-minute bandwidth) and slightly after (more prominently, for the 5-minute bandwidth), where the V-statistics again exhibit negative values. The third one is just after 13:45, at the 5-minute frequency only, when the V-statistics take largely positive values. This last occurrence can be easily interpreted as the fast movement of the bond price to a lower level (that is, to a higher yield) following the news coming from the ECB press conference. These second and third occurrences, however, are non significant when accounting for multiple testing. Thus, interpreting the V-statistic as a test for market efficiency, we cannot reject the efficiency of

Bandwidth: 30 minutes			
	Time at minimum	V-statistics minimum	p-value
31-Mar-2020	10 : 56 : 05	−2.62	0.20
12-Mar-2020	10 : 59 : 17	−5.59	0.00
30-Jan-2020	10 : 54 : 16	−1.30	0.42
30-Dec-2019	11 : 00 : 56	−0.61	0.69
28-Nov-2019	10 : 48 : 30	+0.32	0.92
30-Oct-2019	11 : 10 : 16	−0.07	0.60
27-Sep-2019	11 : 04 : 29	−0.46	0.64
Bandwidth: 15 minutes			
	Time at minimum	V-statistics minimum	p-value
31-Mar-2020	10 : 55 : 53	−3.53	0.10
12-Mar-2020	10 : 59 : 19	−7.35	0.00
30-Jan-2020	10 : 55 : 11	−0.55	0.80
30-Dec-2019	11 : 00 : 56	−0.96	0.61
28-Nov-2019	10 : 59 : 48	−0.03	0.93
30-Oct-2019	11 : 07 : 17	−0.00	0.63
27-Sep-2019	11 : 04 : 29	−0.69	0.53
Bandwidth: 5 minute			
	Time at minimum	V-statistics minimum	p-value
31-Mar-2020	10 : 56 : 04	−2.82	0.19
12-Mar-2020	10 : 59 : 18	−6.11	0.00
30-Jan-2020	11 : 08 : 50	−1.78	0.38
30-Dec-2019	11 : 00 : 31	−2.20	0.11
28-Nov-2019	10 : 59 : 41	−1.61	0.22
30-Oct-2019	11 : 07 : 17	−0.12	0.28
27-Sep-2019	11 : 04 : 29	−0.76	0.52

Table 2: Minimum of the V-statistics, the time at which it was attained and its p-value (estimated using a parametric bootstrap technique based on simulations of the EGARCH(1,1) model) on the seven days in which the 10-year BTP was auctioned. We use three bandwidths for implementation: 5, 15, and 30 minutes.

the secondary bond market for the 10-year BTP neither around the release of the ECB decisions, nor during the subsequent press conference. We instead can reject market efficiency at the auction time. This finding is slightly at odds with the widespread perception (see the quoted press articles) that the release of the ECB decisions disrupted secondary bond markets on that day. Indeed, the only significant price anomaly is during the auction in the morning. The inefficiency that the test unveils is the auction cycle, when the price moves away from its fundamental value because of the temporary selling pressure on the secondary market before the auction time.

Summarizing, this section proves that the auction cycle on 12 March 2020 was strongly statistically significant, that is it cannot be explained by a random fluctuation of bond prices, despite the extremely high volatility observed on that day. We now turn to the policy implications of this result.

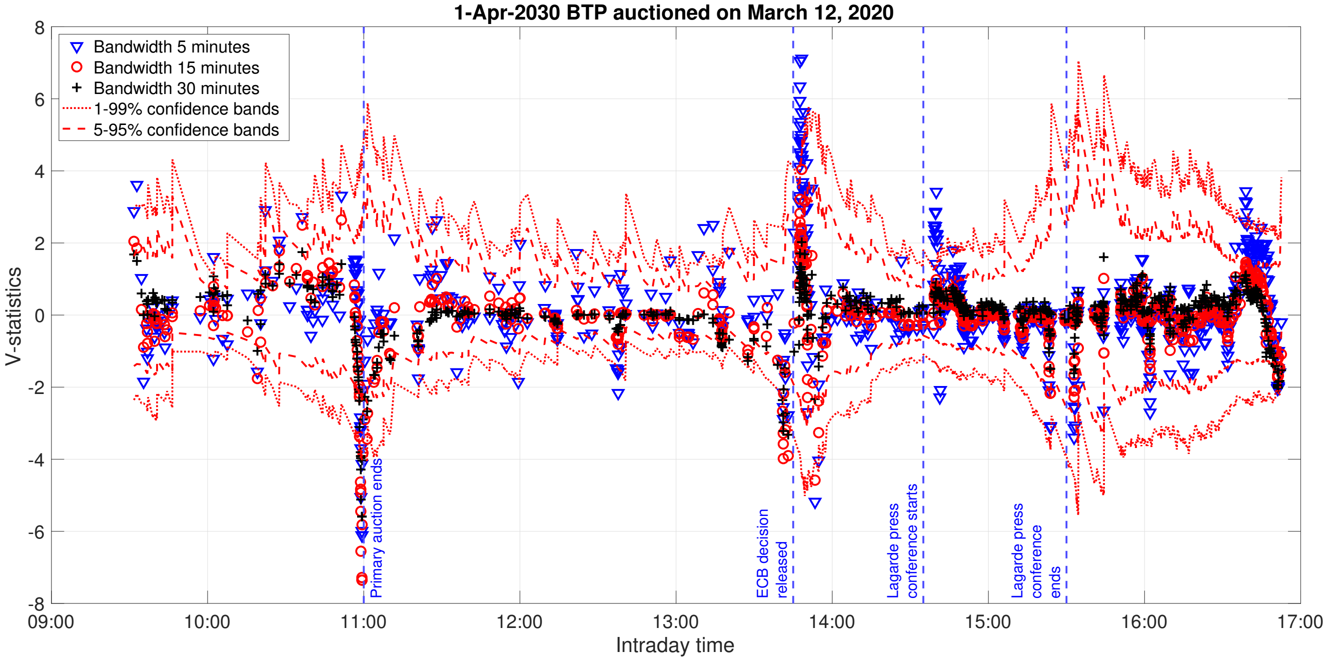

Figure 6: The V-statistic of Flora and Renò (2020) computed on the intraday clean prices of the 10-year BTP auctioned on 12 March 2020 at each transaction time. We use three bandwidths to compute the test: 5, 15 and 30 minutes. Confidence bands are computed with a parametric bootstrap technique in which volatility is filtered with an EGARCH(1,1) model and with 5,000 replications. Confidence bands are reported for the 15-minute bandwidth only.

4 Policy implications

4.1 Italian Treasury issuance cost

The auction of 12 March 2020 offered four different Treasury bonds, all fixed-rate BTPs with maturity of 3, 7, 10, and 20 years. The total amount allocated was 3.5, 0.795, 1.205, and 1.5 billion euros respectively.[5] Figure 7 shows the intraday yields (measured with transaction data in the MOT) in the secondary market of the three auctioned bonds that were already circulating in the secondary market (the 3-year BTP was at its first tranche, thus without a secondary market yet). The yield is larger for the 20-year bond, then the 10-year and 7-year bond follow. The 10-year bond is the most liquid (in terms of number of transactions), followed by the 7-year and the 20-year. However, all three yields follow the same intraday inverse V-shaped pattern, showing an auction cycle for all the auctioned bonds. The three bond yields also show similar behavior after the release of the ECB monetary decision. Beetsma et al. (2016) report, for the 2009 crisis, an auction premium of less than 8 bps (for the Italian 10-year government bond) in a week. This

[5]An additional amount of 1.05, 0.119, 0.181, and 0.3 billion was allocated in a supplementary auction the subsequent day. Since the price in the supplementary auction is fixed at the price of the ordinary auction, no primary dealers requested additional BTPs since the bond prices massively declined on the day after, making the secondary market much more convenient than the primary one.

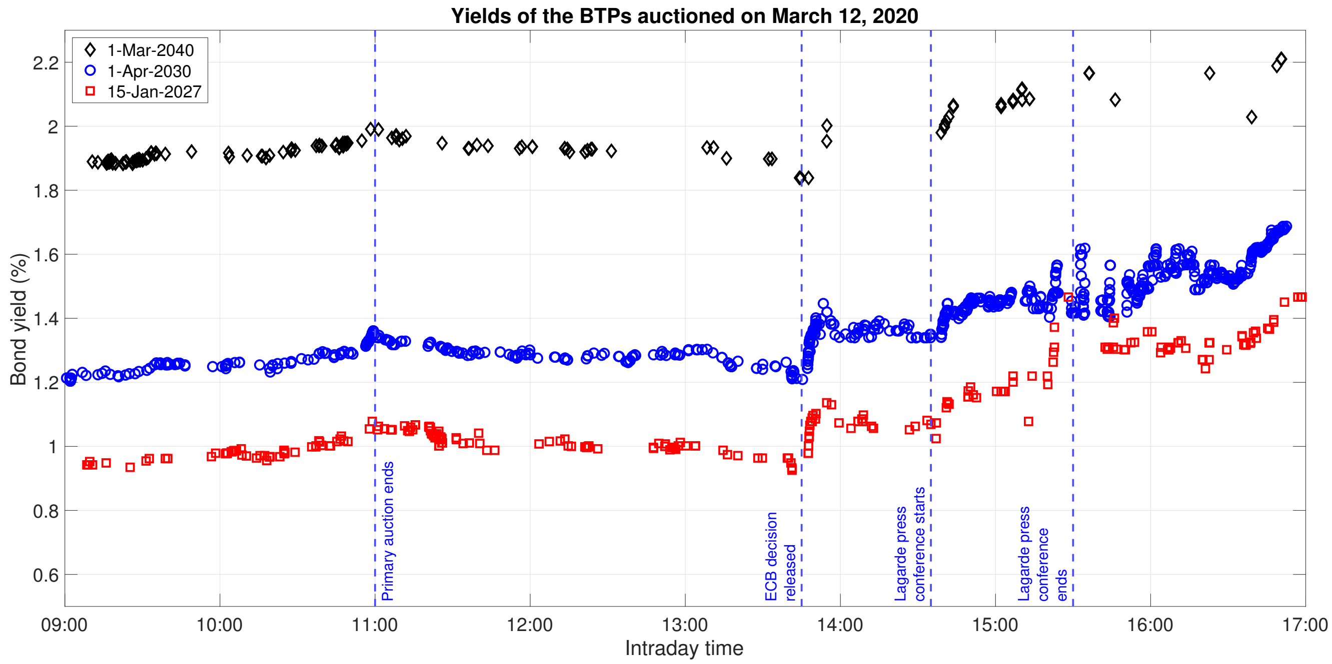

Figure 7: Yields of the three bonds auctioned on 12 March 2020 in the secondary market (MOT). Each point represents a transaction in the MOT.

suggests that the effect of the COVID-19 pandemic was much larger (nearly 20 bps in terms of yield for the 10-year bond, as displayed in Figure 7) than the average effect of the financial crisis of 2009.

We estimate the cost of the significant auction cycle of 12 March 2020 for Italian taxpayers by computing the difference in bond prices between 9:00 (the beginning of the trading day in the MOT) and 11:00 (the auction time). The difference in price is -0.90%, -1.39%, and -1.57% for the 7, 10, and 30 year BTP respectively. The corresponding loss amounts to 47.55 million euros, 1.36% of the amount offered (3.5 billion euro). This wealth was the estimated discount obtained by primary dealers, which has to be considered a lower bound since the calculation ignores the 3.5 billion euros (half of the total size offered) auction on the first tranche of a 3-year BTP for which a secondary market was still not available.

4.2 Why was the second wave less impactful?

On 18 March 2020, the ECB Governing Council announced the PEPP, a 750 billion euro asset purchase program including both public and private sector securities (European Central Bank, 2020a). The ECB also clarified that the PEPP was subject to considerably fewer constraints compared to previous programs and hence granted itself considerable flexibility with respect to which assets' jurisdictions could be included in its asset purchases. Immediately following the announcement, periphery sovereign spreads, which had been rising sharply at the beginning of the year, narrowed markedly.

The PEPP is temporary, but is supposed to run until the COVID-19 crisis is over. In its previously existing program, the ECB purchased bonds in allocations based on the so-called "capital key", purchases of an individual country's public or private bonds that are made based on GDP/population shares within the euro area. That means the ECB cannot skew purchases toward a particular country's bonds since the capital key provision is intended to ensure that monetary policy transmits to the entire region and also mitigates concerns related to monetary financing of governments. However, PEPP provided the ECB with considerable additional flexibility,[6] and allowed it to deviate from the capital key at least temporarily.

That would mean the ECB could skew purchases towards Italy, or another sovereign, in the near term. While the PEPP press release (European Central Bank, 2020a) declared the scheme as a temporary one, it also noted that the Governing Council was "fully prepared to increase the size of its asset purchase programs and adjust their composition, by as much as necessary and for as long as needed". This seemed to suggest that the ECB could increase the size of the PEPP, and if necessary increase its duration. In fact, on 4 June 2020, the ECB Governing Council announced an increase of its PEPP by 600 billion euros (European Central Bank, 2020c) as an attempt to bolster the economy in the euro area even further, taking the total to 1.35 trillion euros. In addition, non-financial commercial paper has also become eligible for purchase. The ECB stated during the same press release that the duration of the PEPP will be extended until June 2021, or until the ECB believes the crisis is over. Lane (2020) discusses how the PEPP's market stabilization role in 2020, combined with the flexibility embedded in the program, allowed for adjustments in the timing and composition of purchases in line with the evolution of market conditions. The author also discusses how the purchases of public sector securities in those countries that were most affected early on by the pandemic have supported confidence and proactively responded to the downward shift in the outlook for growth.

The impact of the monetary policy of the ECB is clearly visible in Figure 8. It shows the intraday prices of the 10-year BTP futures on 29 October 2020. Indeed, 29 October 2020 was very similar, in many respects, to 12 March 2020: a large Treasury auction (6.5 billion euros offered), including 3 billion of a 10-year BTP (namely, the "Btp Tf 0,90% Ap31 Eur" with ISIN IT0005422891, third tranche) took place; COVID-19 cases were on the rise again (second wave, see Figure 4) and reached, on that day, the same level of 12 March 2020; and an ECB monetary policy meeting

[6] While the PEPP is not open-ended, it also differs from the ECB's other large scale purchase schemes in that it is much more flexible. This means there are no announced monthly purchase rates and so operations can vary depending on market conditions.

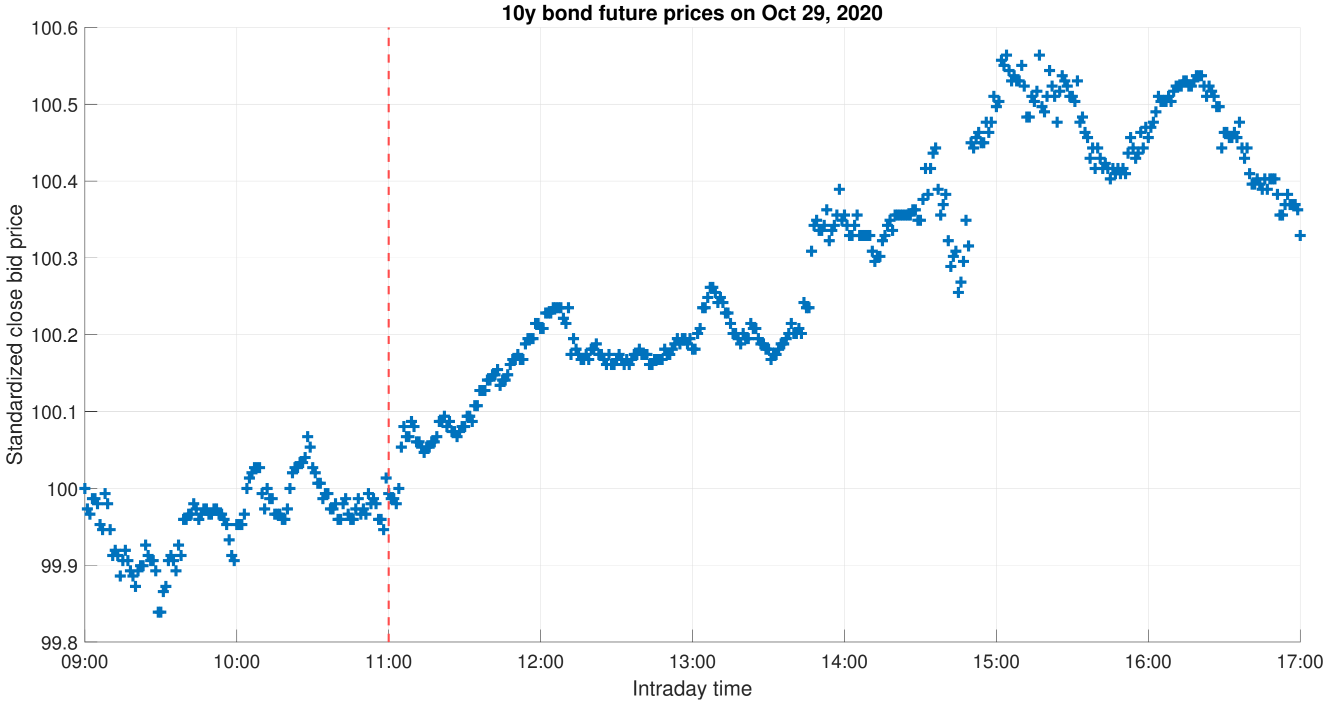

Figure 8: 1-minute closing price bids of the 10-year BTP futures on 29 October 2020. The dashed red line represents the auction time.

was held, which decided to continue the PEPP and other asset purchase programs (European Central Bank, 2020b). Nevertheless, despite all these similarities, Figure 8 shows that the 10-year Treasury prices did not display the V-shaped pattern observed on 12 March at 11:00, that is, there was no significant auction premium. It seems clear that this was due to the calming effects of the aforementioned ECB interventions.

5 Conclusions

The impacts of the COVID-19 pandemic have been wide-ranging upon financial markets and have posed serious challenges to economic policymakers. This paper assesses and quantifies the magnifying effect of the pandemic shock on the auction cycle in the Italian Treasury market. We uncover a strongly significant auction cycle (both in economic and statistical terms) at the peak of the first pandemic wave that is unprecedented with respect to what was found by the existing auction cycle literature. We associate the premium with the abnormal volatility of the secondary bond market, which in turn is associated with the outbreak of the pandemic and with the uncertainty about monetary policy response. We estimate that the additional issuance costs borne by the Italian Treasury during the 12 March 2020 auction amounted to 136 bps of the auction size, while the documented premium in the literature is less than 20 bps. The paper also shows the effectiveness of the ECB interventions after the first wave, with the impact of COVID-19 on Treasury market volatility halving during the second wave, and almost eliminating the additional uncertainty on days with ECB monetary policy decisions. Importantly, we prove the importance of disentangling abnormal deviations due to trends from the random up-and-downs of the price in an efficient market. For this reason, we also advocate for the application of a continuous monitoring of transient price inefficiencies for the most important indices and government bonds, of which the auction cycle is just one prominent example.

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