



BANCA D'ITALIA
EUROSISTEMA

Temi di discussione

(Working Papers)

Financial fragilities and risk-taking of corporate bond funds
in the aftermath of central bank policy interventions

by Nicola Branzoli, Raffaele Gallo, Antonio Ilari and Dario Portioli

March 2023

Number

1404



BANCA D'ITALIA
EUROSISTEMA

Temi di discussione

(Working Papers)

Financial fragilities and risk-taking of corporate bond funds
in the aftermath of central bank policy interventions

by Nicola Branzoli, Raffaele Gallo, Antonio Ilari and Dario Portioli

Number 1404 - March 2023

The papers published in the Temi di discussione series describe preliminary results and are made available to the public to encourage discussion and elicit comments.

The views expressed in the articles are those of the authors and do not involve the responsibility of the Bank.

Editorial Board: ANTONIO DI CESARE, RAFFAELA GIORDANO, MONICA ANDINI, MARCO BOTTONE, LORENZO BRACCINI, LUCA CITINO, VALERIO DELLA CORTE, LUCIA ESPOSITO, DANILO LIBERATI, SALVATORE LO BELLO, ALESSANDRO MORO, TOMMASO ORLANDO, CLAUDIA PACELLA, FABIO PIERSANTI, DARIO RUZZI, MARCO SAVEGNAGO, STEFANIA VILLA.

Editorial Assistants: ALESSANDRA GIAMMARCO, ROBERTO MARANO.

ISSN 2281-3950 (online)

Designed by the Printing and Publishing Division of the Bank of Italy

FINANCIAL FRAGILITIES AND RISK-TAKING OF CORPORATE BOND FUNDS IN THE AFTERMATH OF CENTRAL BANK POLICY INTERVENTIONS

by Nicola Branzoli*, Raffaele Gallo*, Antonio Ilari** and Dario Portioli***

Abstract

This paper provides evidence that, by restoring market functioning, central banks' pandemic-related asset purchase programmes lowered payoff complementarities among investors in corporate bond funds, reinforcing asset managers' willingness to hold riskier assets to increase funds' returns. Controlling for potentially confounding factors, we show that funds more exposed to these interventions – i.e. those which immediately prior to the pandemic crisis held a high share of securities eligible for inclusion in purchase programmes – took on more credit and liquidity risks than less exposed ones. Risk-taking was stronger when more exposed funds under-performed their peers or held less liquid assets. We discuss the implications for the design of policy interventions in the aftermath of market stress and the regulation of the investment fund sector.

JEL Classification: E50, G01, G11, G23.

Keywords: corporate bond funds, market stress, asset purchase programmes, risk-taking.

DOI: 10.32057/0.TD.2022.1404

Contents

1. Introduction	5
2. Overview of the bond fund industry, data and variable construction	10
2.1. Institutional background on the functioning of bond funds	10
2.2. Data and sample construction.....	12
2.3. Measuring active-risk taking	14
3. Results	15
3.1. Graphical analysis of the corporate bond fund sector in the crisis aftermath	15
3.2. Baseline estimates	18
3.3. Reverse tournaments	22
3.4. Identification issues	23
3.5. Risk-taking of more fragile funds.....	24
4. Conclusions	26
References	28
Appendix	30

* Bank of Italy, Directorate General for Economics, Statistics and Research – Financial Stability Directorate.

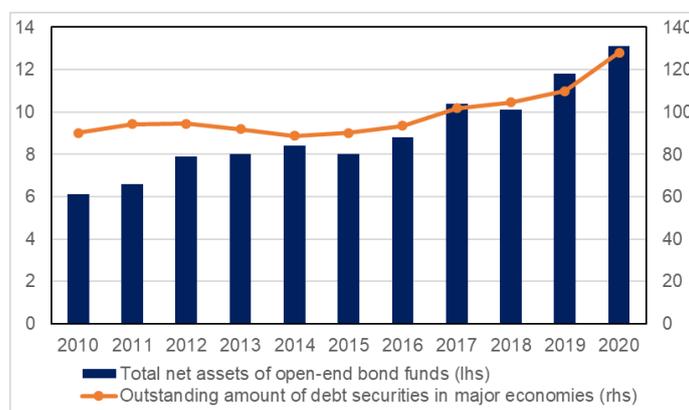
** Bank of Italy, AML Supervision and Regulation Unit.

*** Bank of Italy, Directorate General for Financial Supervision and Regulation.

1. Introduction¹

During the last decade, open-end bond mutual funds have attracted significant amounts of resources. Since 2010, their total assets under management have more than doubled at the global level, to \$13 trillion, outpacing the growth of outstanding debt securities (Figure 1). This expansion comes with benefits and risks for the real economy and the financial system. On the one hand, it improves the ability of the non-financial sector to diversify its funding sources and obtain credit when the supply of bank loans falls (Becker and Ivashina, 2014). On the other hand, the increasing role of bond funds in financing the economy could become a source of instability for markets and other intermediaries (Falato et al., 2021), pointing to the need to develop a deeper understanding of their vulnerabilities.

Figure 1 – The growth of corporate bond funds and market-based debt



Note: This figure plots the annual time series of the total amount of net assets of bond funds at the global level and the sum of the outstanding amount of debt securities issued in US, Euro Area, United Kingdom, China, Japan and Canada. Data are expressed in trillions of dollars. Source: Investment Company Institute Fact books and Bank for International Settlement (debt securities database).

In this paper we show that financial fragilities associated to liquidity mismatch were key drivers of corporate bond funds' risk-taking after the outbreak of the COVID-19 pandemic and the policy interventions that followed it. In late January 2020 stock market indices started to decline and sovereign bond yields fell substantially due to increasing investor demand for safe and liquid assets (FSB, 2020). In the second half of February the shock unravelled in the corporate bond market, with a sudden increase in spreads between investment grade (IG) and high-yield (HY) bonds and significant outflows from corporate bond funds across investment styles (Falato et al., 2021). In mid-March, public authorities announced a wide range of unprecedented policy measures to mitigate the

¹ We thank Alessio De Vincenzo, Emilia Bonaccorsi di Patti, Francesco Columba, Giuseppe Cappelletti, Luca Zucchelli, and the participants to the Task Force on Banking Analysis for Monetary Policy 8th Research Workshop for their comments. The views expressed in this paper are those of the authors and do not reflect those of the Bank of Italy.

impact of the pandemic and ease financial market strains, including purchase programmes of corporate bonds. These interventions were necessary and effective in mitigating financial markets' stress, reducing the level and the volatility of market rates and funds' exposure to significant outflows. However, material risks remained associated to the potential effects of the pandemic until late November, when experimental trials demonstrated that COVID-19 vaccines were highly effective. During most of 2020, the VIX index and spreads between IG and HY bonds fluctuated around levels that were twice those observed at the end of the previous year.²

Market tensions highlighted the vulnerabilities in the open-end corporate bond mutual fund sector. Indeed, the presence of transaction costs (e.g. high bid-ask spreads) in less liquid markets such as the corporate bond market³ creates payoff complementarities among investors in funds that offer daily redemption terms. Liquidation costs incurred by asset managers to redeem outgoing investors in fact tend to reduce the return for those remaining in the fund (Goldstein et al., 2017). This externality is associated with the risk of pre-emptive runs by shareholders willing to withdraw money from the fund if they expect others to do so, making net flows from bond funds highly sensitive to bad performance. When uncertainty is high, as in the aftermath of the pandemic outbreak, financial fragilities associated to liquidity mismatch in the corporate bond fund sector may reduce risk-taking. Asset managers have the incentive to hold cash and liquid assets to meet redemptions at lower costs (Chernenko and Sunderam, 2020; Simutin, 2014) and limit the share of illiquid investments in order to mitigate the risk of significant outflows or runs.

In the case of the pandemic crisis, the policy measures that were primarily aimed at supporting market liquidity, which were key to restore market functioning and address systemic risks, may have unintendedly weakened this incentive. By reducing transaction costs in the corporate bond market (O'Hara and Zhou, 2021), we hypothesize that authorities' interventions that restored market functioning have also lowered payoff complementarities and the risk of runs by investors in corporate bond funds, thus potentially reinforcing managers' willingness to hold riskier assets in order to increase fund returns.

Moreover, authorities' interventions may have affected funds' response to competitive pressure from their peers. The literature suggests that mutual funds' managers have an incentive to outperform other intermediaries in order to attract inflows (Lazear and Rosen, 1981), following a so-called rank-chasing (tournament) behavior. However, recent studies suggest that bond funds play a "reverse tournament" due to the concave flow-performance relationship. In case of underperformance, funds'

² In the second half of 2020, option-adjusted spreads of ICE BofAML Global Corporate Index and ICE BofAML Global High Yield Index fluctuated around 600 bps vs. 300 bps in January.

³ Corporate bonds are mostly traded in over-the-counter dealer markets with significant transaction costs (Edwards et al., 2007).

managers de-risk their portfolios by selling high yield bonds and purchasing safe and liquid assets in order to be ready to meet redemptions (Cutura et al., 2020), rather than increasing risk levels to improve their ranking against other managers (as equity funds do). By reducing the risk of runs, policy measures aimed at supporting market liquidity may have strengthened the rank-chasing behaviour of corporate bond funds, mitigating funds' incentives to de-risk after poor performance.

To analyze the risk-taking behavior of open-end corporate bond funds in the aftermath of market stress, we collect monthly security-level information on portfolio holdings of all actively managed EU and US corporate bond funds. We merge this information with market data to construct, for each bond in our sample, a measure of credit risk based on credit ratings and one of liquidity risk based on Roll (1984)'s proxy for the bid-ask spread commonly used in the literature (see Section 2.2 for more details). We use these variables to measure funds' portfolio risk, i.e. the weighted average of bonds' credit risk and liquidity risk using portfolio weights, and active risk-taking (Cutura et al., 2020), i.e. changes in credit and liquidity risks due to fund managers' decisions to increase their exposure to risky and illiquid assets.⁴

We combine these data with information about eligibility criteria of asset purchase programmes activated by all major central banks during the COVID-19 pandemic to investigate the potential relationship between funds' risk-taking and their exposure to bonds targeted by these policy measures. In the rest of the paper we will refer to asset purchase programmes activated by the FED, ECB, Bank of England, Bank of Japan, Riksbank and Bank of Canada in March 2020 as AP-C19. We measure funds' exposure to AP-C19 using the pre-pandemic exposure (i.e. the share of eligible assets observed in February 2020) in order to avoid potential endogenous changes of this variable due to central banks' announcements.⁵

The aggregate evidence about the evolution of funds' riskiness in 2020 indicates that, between February and December 2020, the share of HY bonds and the Roll illiquidity measure of funds' portfolios grew on average by almost 1 percentage point and 30 per cent, respectively. In the same period, on aggregate, funds more exposed to AP-C19 reduced the average rating of their portfolio by about three notches (i.e. from A-/A3 to BBB-/Baa3), while those less exposed decreased it by slightly more than one notch (i.e. from BBB+/Baa1 to about BBB/Baa2). The former group of funds provided higher returns to their investors and attracted larger inflows in the months following the outbreak.

⁴ Differentiating between overall portfolio risk and active risk-taking allows us to distinguish changes in risk due to market dynamics (i.e. credit rating downgrades or reductions in trading volumes) and changes due to asset managers' decisions.

⁵ However, as shown below, funds' exposure to AP-C19 remained relatively stable throughout 2020. Consistent with this evidence, our results are quantitatively confirmed if we use the time-varying monthly share of eligible assets rather than the share observed in February.

Also controlling for observed and unobserved fund heterogeneity,⁶ we find that intermediaries with high pre-pandemic exposure to AP-C19 increased both credit and liquidity risks of their portfolios more than their peers with low exposure. In particular, a difference of 20 percentage points in the share of the portfolio eligible for AP-C19 (equivalent to the inter-quartile range) is associated with a monthly decrease of about 0.1 points in the average credit rating⁷ and with a rise in the illiquidity measure of 1.3 points (i.e. 30 per cent of the standard deviation in the same period). These increases in the average portfolio riskiness are also economically significant: for example our estimates show that the impact of exposure to AP-C19 is associated with an overall increase of \$107 billion in the exposure to HY bonds during the considered period (23 per cent of the amount of these securities in funds' portfolios at end-February). This evidence is consistent with the hypothesis that the pandemic-related policy measures may have strengthened funds' risk-taking incentives.

We also show that highly exposed funds actively took on more risk mainly on the non-eligible portion of their portfolios. After the introduction of purchase programmes, fund managers did not significantly modify their exposures to, nor the composition of, assets eligible for AP-C19, suggesting that most portfolio adjustments involved bonds that were not directly targeted by policy measures.

The rise in funds' risk-taking were larger in the second quarter of 2020 and diminished over the course of the year, suggesting that the impact of policy interventions on funds' investment behaviour was stronger right after periods of intense market stress.

Afterwards, we focus on how the introduction of AP-C19 programmes affected funds' response to competitive pressure from their peers. Consistent with the "reverse tournament" hypothesis, we show that, on average, funds underperforming their peers decrease the credit and liquidity risk of their portfolios. However, funds' exposure to AP-C19 mitigated such incentive in the month following a period of poor performance. We find that underperforming funds with a higher exposure to eligible bonds increased the riskiness of their portfolio, rather than reduce it. This suggests that policy measures aimed at supporting market liquidity have also strengthened the rank-chasing behaviour of corporate bond funds.

We address potential identification issues related to the effect of exposure to bonds eligible for AP-C19 on active risk-taking and rank-chasing behaviour. Indeed, the investment strategies of funds more exposed to AP-C19 may be structurally different than those adopted by less exposed

⁶ To address potential identification concerns related to observable and unobservable factors that may influence fund risk-taking, we include fixed effects at the fund domicile level and at the time-fund category (based on the predominant investment objective) one.

⁷ The corresponding cumulative reduction in the average rating during the last nine months of 2020 for more exposed funds is 0.5 points greater than for less exposed ones, more than double of the average decline in the portfolio rating observed in our sample during the same period.

intermediaries. First, evaluating the differences between more and less exposed funds before the pandemic outbreak we find that highly exposed funds on average hold *less* risk than others as their portfolios have higher average ratings and liquidity. Second, to address this issue, following the approach proposed by Falato et al., (2021), we exploit a unique feature of the FED program that included a 5-year maturity threshold to determine eligible assets.⁸ For each fund, we construct the share of eligible bonds (i.e. 4 to 5 years of maturity) and that of quasi-eligible bonds (i.e. securities with 5 to 6 years of maturity and that would have been otherwise eligible for FED purchases). We define as “treated” (“control”) funds those in the top quartile of exposure to eligible (quasi-eligible) bonds in February 2020. With this approach, treated and control funds hold similar assets (those eligible or quasi-eligible for FED purchases), although with slightly different maturities (between 4 and 6 years). The results on the impact of AP-C19 on active risk-taking and rank-chasing behaviour are robust to performing this check as we find that treated funds increased their riskiness exposure more than control ones.

Finally, we show that financial fragilities due to liquidity mismatch are, in general, associated with lower risk-taking. Funds that before the pandemic had higher shares of HY bonds or less liquid portfolios increased the riskiness of their portfolios less than more resilient funds, suggesting that strategic complementarities among investors deter fund risk-taking in the aftermath of market stress. However, consistent with our main findings, fragile funds highly exposed to AP-C19 de-risked less than low exposed ones.

Overall, our analysis provides new insights for understanding the reaction of investment funds to policy measures. Central banks’ interventions were key to restore market functioning and it cannot be excluded that some forms of external support provided by central banks may be necessary again in future periods of extreme market stress. However, our results suggest that these interventions may be associated with an increase in funds’ incentives to take risks. The incentives to take more risk is stronger in the short run (i.e. in the quarter following the policy introduction) but it results in an upward shift in their riskiness exposure that is not rebalanced in the following periods (at least after about nine months). These unintended effects may be addressed by introducing policies that restrict ex-ante risk taking in the bond fund sector (Giuzio et al., 2021).

Our paper contributes to the literature on risk-taking by non-bank financial intermediaries in the aftermath of market stress. Kacperczyk and Schnabl (2015) and Strahan and Tanyeri (2015) examine the risk-taking behaviour of money market funds during the great financial crisis of 2008 (GFC). Consistent with our analysis, these studies find that funds that experienced larger outflows reduced

⁸ Other central banks did not generally introduce a similar threshold based on bond maturity to define eligible assets.

risk relative to their initial holdings before the crisis. Becker and Ivashina (2015) provide evidence that reaching for yield by insurers, pension funds and mutual funds weakened after the GFC, in contrast with the aggregate evidence provided in this paper. Feroli et al. (2014) highlight that risk-taking by mutual funds decreased after the taper tantrum of 2013. Recently, Giuzio et al. (2021) find that expansionary monetary policies are followed by an increase in inflows for funds investing in riskier asset classes (e.g. high yields) as well as by a reduction in cash buffers by fund managers. We complement these studies by showing how the linkage between financial fragilities and risk-taking in the aftermath of a market stress has been affected by the introduction of AP-C19.

We also contribute to the literature on the effect of policy measures adopted to address the impact of the pandemic on financial markets. Numerous studies show the effectiveness of policy measures aimed at supporting market liquidity in terms of lower transaction costs and higher liquidity in corporate bond markets (Affinito and Santioni, 2021; Boyarchenko et al., 2022; Haddad et al., 2021; Kargar et al., 2021; Ma et al., 2022; O’Hara and Zhou, 2021). Falato et al. (2021) show that these interventions were also effective in stabilizing and reversing outflows from corporate bond mutual funds, with beneficial spillovers on primary market issuance of corporate bonds and funds less exposed to these measures. Our contribution is to show that there may be a positive spillover of asset purchase programmes: notwithstanding central banks’ interventions targeted a group of eligible securities, also the market of not eligible assets (e.g. HY bonds) may have benefitted from an increase in purchases by funds exposed to the AP-C19 programmes. This “bond fund channel” indicates that the positive impact of central banks’ asset purchases may be not limited to the primary bond market or to eligible securities.

Finally, we contribute to the growing literature on corporate bond funds (see e.g. Chen et al., 2010; Choi and Kronlund, 2018; Cici et al., 2011; Cutura et al., 2020; Goldstein et al., 2017) by assessing the impact of policy measures that reduce transaction costs in the bond market on the tournament behavior of funds.

2. Overview of the bond fund industry, data and variable construction

2.1. Institutional background on the functioning of bond funds

Since the global financial crisis, debt markets have been affected by a number of changes in the context of broader G20 post-crisis regulatory reforms and market-driven adjustments. On the one hand, accommodative monetary policies and search for yield by investors have boosted both supply and demand of bonds. The amount of new bond issuances by non-financial companies each year in advanced economies has indeed more than doubled, to around \$2 trillion (OECD 2020).

On the other hand, tighter prudential regulations for banks contributed to the reduction of market-making activities (Bao et al., 2018), increasing the proportion of volumes negotiated by dealers as agency trades relative to principal trades (FSB, 2020). These changes had a significant impact on the degree of liquidity of debt markets, which are normally characterised by limited automated trading and substantial reliance on dealers' market-making activities. The reduced role of banks implied that the risk-taking behaviour of other non-banking financial intermediaries (NBFI) and their ability to effectively manage market and liquidity risks has become key to achieve financial resilience in times of stress.

To improve our understanding of the risk-taking behaviour of NBFI, this paper studies open-ended bond funds, whose growth in the last decade has kept pace with the expansion of bond markets (Goldstein et al., 2017).

One of the key structural vulnerabilities of open-ended bond funds is the potential mismatch between the liquidity of their assets and daily redemption terms of fund units (FSB, 2017). Liquidity mismatch in bond funds may be a source of financial fragility. Bond fund investors might have an incentive to withdraw their investments in advance of other fund investors when they expect to receive a liquidation value that exceeds their net asset value. Therefore they may withdraw money when they perceive that the risk of redemptions by other investors is rising (so-called "first mover advantage"). Valuation risks originated by stale prices and specific liquidation strategies (e.g. cash hoarding and "horizontal slice" versus "vertical slice") may reinforce such "first mover advantage" in stressed market conditions.

The role of bond funds in the amplification (or mitigation) of shocks depends also on their strategic reaction to poor performances. This idea has been mainly explored in the case of equity funds via the theory of tournaments (Lazear and Rosen, 1981): underperforming equity fund managers increase risk-taking, gambling to improve their relative performance against their peers. This result is dependent on the incentive structure of equity fund managers. The potential upside in terms of improving their relative performance and attracting new flows is large, whereas downside risk in terms of outflows is contained.

In the case of bond funds, Choi and Kronlund (2018) show that the illiquid nature of corporate bonds reduces the incentives of corporate bond funds to adopt "reaching-for-yield" strategies. Indeed, recent research shows that "reverse tournament" may normally take place (Cutura et al., 2020): when their performances are worse than those of their peers, fund managers de-risk their portfolios by selling high yield bonds and purchasing lower yield bonds. As a result, corporate bond funds exhibit a concave flow-performance relationship as the downside risks in terms of outflows are higher if they underperform their peers (Goldstein et al., 2017).

These findings have implications for financial stability risks as they suggest that the industry can adopt self-adjusting behaviors to mitigate risks and avoid gambling effects. We investigate this issue by analyzing whether “standard” or “reverse” tournament take place in case of a severe shock, as the pandemic outbreak, which is followed by massive monetary interventions.

The COVID-19 crisis represents an opportunity to investigate the risk-taking behaviour of open-ended bond funds in the aftermath of extreme market stress and in the context of post-crisis regulatory reforms. After the pandemic outbreak in March 2020, transaction costs soared and dealers shifted from buying to selling securities (O’Hara and Zhou, 2021). Contemporaneously, corporate bond funds suffered large outflows. The growing literature on the dynamics of these outflows has highlighted that the degree of illiquidity of fund portfolio amplified market fragility, given that illiquid funds suffered more severe outflows than liquid funds (FSB, 2020).

Central bank interventions, together with other public sector measures targeting the real economy, successfully mitigated market stress (O’Hara and Zhou, 2021). Absent these interventions, it is widely agreed that stress in the financial system would have worsened. This suggests that, to understand the risk-taking behaviour of open-ended bond funds in the aftermath of extreme market stress, it is important to take into account the potential effects of measures that might be necessary to restore market functioning.

2.2. Data and sample construction

Our dataset combines information on funds’ securities holdings, their characteristics and the eligibility criteria of pandemic-related corporate sector purchase programmes by central banks.

We obtain data on open-end bond funds’ portfolios at the global level from the Morningstar database, which covers the universe of all actively managed funds.⁹ For each fund with size greater than \$10 million and domiciled in the main advanced countries (France, Germany, Ireland, Italy, Luxembourg, Spain, UK, and US), we retrieve monthly information on net flows, returns, total assets under management (AuM), the amount and identification number (the International Securities Identification Number, ISIN) of each security held in the portfolio, as well as other characteristic (e.g. the category based on the predominant investment objective). By relying on Morningstar “Global Category”, we exclude funds that invest in US Municipal bonds, Asia-Pacific or Emerging Markets because these categories have almost no exposures to AP-C19 given their investment mandate. We focus on the period from December 2019 to December 2020.

⁹ We do not analyse exchange traded funds or money market funds given their specific characteristics.

We merge information at the security-fund level with the Centralized Securities Database (CSDB), a database maintained by the European System of Central Banks (ESCB) which provides data on all traded securities ever held by at least one intermediary reporting information to the ESCB. In particular, we use CSDB to construct a measure of credit risk based on credit ratings for each security in our dataset. In particular, we retrieve credit ratings for each bond and we assign a score to each rating by adopting a 22-level scale (e.g. 22 is assigned to AAA/Aaa level and 1 to D).¹⁰

Moreover we also estimate a measure of liquidity risk based on the Roll (1984)'s illiquidity measure, which proxies for the bid-ask spread.¹¹ These indicators are generally correlated, as safer assets tend to be more liquid.¹² However, they could differ as bonds in a same rating class may have a different liquidity. For example, investment grade securities traded in the US bond market are generally more liquid than those traded in smaller markets.

Information on pandemic-related corporate sector purchase programmes come from the BIS (2021) dataset and central banks' websites. The BIS database contains the list of all corporate sector purchase programmes activated at the global level in March 2020 and their characteristics (e.g. date of announcement, size of the program). Central banks' websites provide detailed information on eligibility criteria of each program. By combining eligibility criteria with securities' characteristics, we distinguish eligible and not eligible bonds for programmes implemented by the FED, the ECB, the Bank of England, and other major central banks (i.e. Bank of Japan, Riksbank and Bank of Canada).¹³ These programmes were largely developed using a coordinated approach. Broadly, central banks considered eligible bonds issued by resident non-financial corporations (e.g. companies domiciled in US for FED programmes) and rated investment grade. Each authority added further specific features, such as maturity thresholds (e.g. less than 5 years for FED programmes, more than 12 months for those of the Bank of England), that we use to identify eligible securities.

¹⁰ From the CSDB we obtain credit ratings issued by the main four agencies. To establish the rating category for issuers with multiple credit ratings, in line with the most prevalent institutional rule (O'Hara and Zhou, 2021), we use the lowest rating for issuers with two ratings, the middle one for those with three or more ratings.

¹¹ For each bond, $Roll_t = 2 \sqrt{-cov(r_t, r_{t-1})}$, where r_t is bond return in month t . The Roll measure at date t is computed using the covariance between bond returns and their lagged values in the 12 months prior to month t . The indicator is set equal to 0 if the covariance is greater than or equal to zero. Under certain assumptions, the Roll measure is equal to the bid-ask spread of traded securities. The Roll measure is higher for more illiquid bonds as it would suggest a greater negative covariance between returns, which is in turn associated with higher bid-ask spreads. In line with the literature (Cutura et al., 2020; Goldstein et al., 2017), for each fund we aggregate the bond-level Roll measure by taking the value-weighted average at the portfolio level.

¹² Our liquidity measure is computed only on the share of bonds; consequently we do not take into account the amount of cash held by each fund, nor the liquidity of other holdings. This choice, in line with other comparable works (Cutura et al., 2020; Goldstein et al., 2017), is motivated by the lower availability of information on non-bond assets. However, in unreported robustness checks we have verified that our results are robust to computing the Roll measure on the overall fund portfolio, including non-bond securities for which information are available. In this test we assign to the amount of cash held by each fund a Roll indicator equal to 0 (i.e. the maximum liquidity degree).

¹³ The programmes implemented by other central banks are not considered because funds did not held a substantial amount of securities eligible for these programmes.

We aggregate these information at the fund level using monthly portfolio weights, i.e. the share of fund's total assets invested in a given security. In particular, we construct monthly measures of fund's credit and liquidity risks using a weighted average of credit and liquidity risks of funds' assets. To investigate the robustness of our baseline results, we also analyse alternative measures of riskiness, such as the share of high-yield bonds held by each fund as well as the weighted average yield and maturity of bonds held by each fund (see Appendix for more details). Similarly, we compute the monthly share of the portfolio of each fund invested in eligible bonds at the end of February 2020, aggregating information on holdings of bonds eligible under the pandemic-related corporate sector purchase programmes.

Our initial sample consists of 4,616 funds with around \$4 trillion AuM at the end of January 2020. To construct the final sample, we apply further restrictions based on data availability. We focus on funds that appear in all months (i.e. closed sample) and for which we have information on risk-taking measures in all dates for at least 80 per cent of the portfolio. Our final sample consists of 2,560 funds with about \$3 trillion AuM before the pandemic (about 80 per cent of the initial sample AuM). Figure A.1 in Appendix reports AuM composition by fund category and domicile.

2.3. Measuring active-risk taking

Following Cutura et al. (2020), the change between the average riskiness of the portfolio of fund f between month $t-1$ and t is computed using Eq. (1).

$$\Delta Risk_{f,t} = \sum_{j=1}^{N_{f,t}} \lambda_{f,j,t} \times Riskiness_{j,t-1} - \sum_{j=1}^{N_{f,t-1}} \lambda_{f,j,t-1} \times Riskiness_{j,t-1} \quad (1)$$

$Riskiness_{j,t-1}$ is either bond rating or Roll illiquidity measure (respectively for credit and liquidity risk) of asset j in month $t-1$. The security-level weights $\lambda_{f,j,t}$ and $\lambda_{f,j,t-1}$ used for the aggregation are given by:

$$\lambda_{f,j,t} = \frac{P_{j,t-1} Q_{f,j,t}}{\sum_j P_{j,t-1} Q_{f,j,t}} \quad \lambda_{f,j,t-1} = \frac{P_{j,t-1} Q_{f,j,t-1}}{\sum_j P_{j,t-1} Q_{f,j,t-1}}$$

where $P_{j,t}$ and $Q_{f,j,t}$ are the price and the amount of bond j held by fund f at time t .

In Eq. (1) the only variable that changes between t and $t-1$ is the quantity of each asset in the fund portfolio ($Q_{f,j,t}$) while prices and risk measures remain constant at their values in $t-1$. As a result, $\Delta Risk$ describes the active rebalancing of the portfolio of fund f in month t because any change in this

measure arises entirely from variations in the portfolio weight given to each asset and not from variations in its price or its riskiness.

Moreover, $\Delta Risk$ is not affected by net flows at fund level. Indeed, this measure is flow-neutral as long as fund managers maintain unaltered the proportion allocated to each category of securities with the same level of riskiness (Cutura et al., 2020; Manconi et al., 2012).¹⁴

Overall, our main risk-taking measures are: $\Delta Rating$, which is the monthly change in the weighted average rating of bonds held by fund f between t and $t-1$, and $\Delta Illiquidity$, which is the monthly change in the Roll illiquidity measure of fund f between t and $t-1$.¹⁵ To ease the interpretation, $\Delta Illiquidity$ is standardized to have mean zero and standard deviation of one.

3. Results

3.1. Graphical analysis of the corporate bond fund sector in the crisis aftermath

Before describing the results of a multivariate analysis that takes into account funds' characteristics and potential identification issues, we provide a broad overview of open-ended corporate bond funds' risk-taking in 2020.

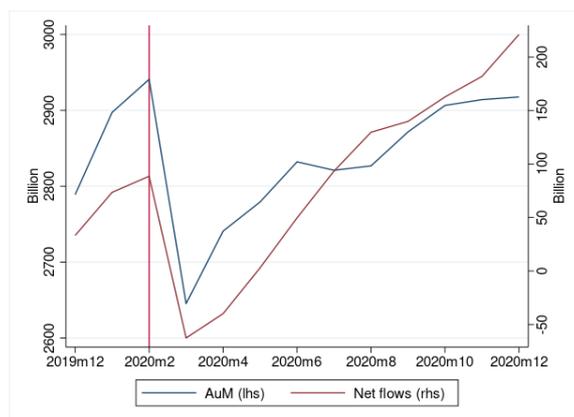
Figure 2 presents the change in AuM and net flows. The value of assets decreased immediately after the pandemic outbreak (about 13 per cent) and returned at the pre-crisis level only at the end of 2020. Net outflows lasted until May, while inflows were reported from June onward.

In March, the average liquidity and credit quality of fund portfolios improved, suggesting a flight-to-safety/liquidity by fund managers, and then worsened significantly in April. During the rest of 2020, credit risk continued to increase while liquidity risk slightly decreased, consistent with the gradual improvement of financial market conditions throughout 2020. At the end of the year, both credit and liquidity risks were above levels observed before the crisis.

¹⁴ For example, if inflows for fund f in a given month are 2 per cent of its asset under management, $\Delta Risk$ would not change as long as fund f raises the exposure to each security in the portfolio, or any other security with the same riskiness (e.g. AAA rated bonds), by 2 per cent.

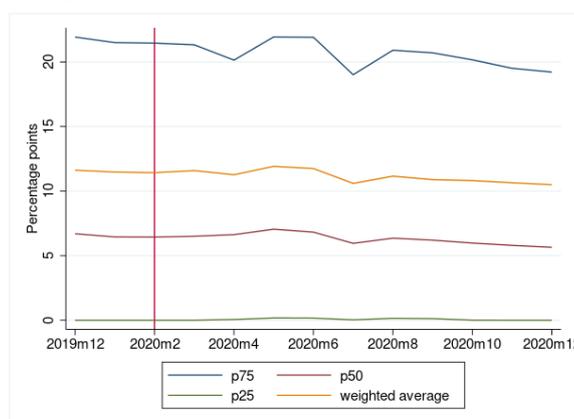
¹⁵ As a robustness check we also use: $\Delta ShareHY$, which is the monthly change in the share of high-yield bonds held by fund f between t and $t-1$; $\Delta Yield$, which is the change in the weighted average yield of bonds held by fund f between t and $t-1$; and $\Delta Maturity$, which is the change in the weighted average remaining maturity of bonds held by fund f between t and $t-1$ (see Table A.2). Finally we estimate a principal component analysis (PCA) by calculating the principal component of the measures relating to credit risk (i.e., $\Delta Rating$, $\Delta ShareHY$, $\Delta Yield$, and $\Delta Maturity$). In particular, the eigenvalue of the adopted component is equal to 1.01 and the explained variation is about 25 per cent.

Figure 2 – Change in AuM and net flows between December 2019 and December 2020.



Note. The figure shows, on aggregate, the change in asset under management and net flows, expressed in billions of dollars.

Figure 3 – Share of eligible assets across funds.



Note. The figure shows the distribution of the share of eligible assets (expressed in percentage points) across funds from December 2019 to December 2020.

Figure 3 presents the distribution of the shares of assets eligible for AP-C19 across funds. These shares vary significantly across funds, with an interquartile range of about 15 percentage points, but they are relatively stable for each fund over time,¹⁶ suggesting that intermediaries did not significantly change their exposure to eligible assets after the introduction of AP-C19. As a result, any change in the average credit quality should mainly derive from a reallocation in the portfolio of not-eligible assets. Figure A.2 in Appendix reports the composition of eligible assets by central bank program.

Given that the share of eligible assets did not significantly vary in the period examined in our analysis, we can divide the funds in two groups, “more exposed” and “less exposed”, depending on the relative level of their exposure to AP-C19 in February 2020 (above or below the median, respectively). Table 1 shows the summary statistics observed for both groups before the pandemic

¹⁶ In an unreported model we confirm that the change in the share of eligible assets between February 2020 and December 2020 was very low for funds both on average and in each quartile of the distribution of eligible assets (as of February 2020).

outbreak (February 2020). Our evidence suggests that funds more exposed to AP-C19 held ex-ante less risks than less exposed ones as their portfolios have on average higher rating and liquidity, as well as a lower share of high yield bonds, yield and maturity. These differences remain significant also considering only the share of not eligible securities.

Table 1 – Ex-ante mean differences across more and less exposed funds (as of February 2020).

	More Exposed	Less Exposed	Difference
Rating (<i>rating points</i>)	15.74	14.97	0.77***
Illiquidity (<i>points</i>)	1.27	1.90	-0.62***
Share HY (%)	11.37	30.97	-19.60***
Yield (%)	1.37	2.23	-0.86***
Maturity (<i>months</i>)	113.12	127.04	-13.92***
Exposure _{feb} (%)	25.32	0.99	24.33***

Note. More exposed funds are those with a share of assets eligible for AP-C19 above the median in February 2020. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The t-test is based on the assumption that the two groups of funds have different variances.

Notwithstanding the ex-ante differences between the two groups suggesting that highly exposed funds hold less risk than less exposed funds, we observe that both the average portfolio rating and liquidity of intermediaries more exposed to AP-C19 decreased more than those of less exposed ones after the implementation of CB interventions (Figure 4).¹⁷ In particular, highly exposed funds reduced the average rating of their portfolio by about three notches (i.e. from A-/A3 to BBB-/Baa3), while those less exposed decreased it by slightly more than one notch (i.e. from BBB+/Baa1 to about BBB/Baa2). This preliminary evidence is in line with the hypothesis that bond funds more exposed to AP-C19 took on more risk than less exposed funds after the introduction of these programmes.

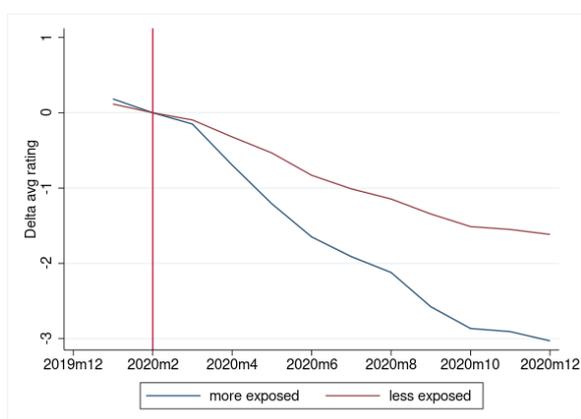
More and less exposed funds also differ with respect to net flows as well as performances, consistent with Breckenfelder et al. (2021). For both groups, net subscriptions and the average returns¹⁸ were similar before the pandemic outbreak, as shown in Figure 5. In contrast, a large gap between the net flows and performances of the two groups emerged after the end of February. In particular, both groups experienced significant outflows in March, but highly exposed funds reported positive net subscriptions from April, while for low exposed ones positive net subscriptions started only in August.

¹⁷ At this stage, we do not control for the contemporaneous reduction in credit quality due to downgrades of credit ratings. However, since the pandemic outbreak was a widespread shock, downgrades should have on average a similar impact on the portfolios of funds. As a result, this descriptive evidence should not be primarily driven by a greater share of downgraded assets in the portfolios of low exposed funds.

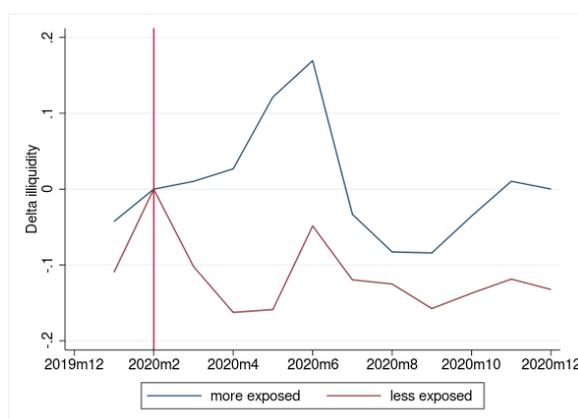
¹⁸ Adjusted for the median return of each fund category, i.e. Europe, International, Mixed, UK, and US.

Figure 4 – Change in risk-taking measures across more and less exposed funds (index: February 2020=0).

a) Cumulative change in the average credit rating



b) Cumulative change in the average illiquidity measure

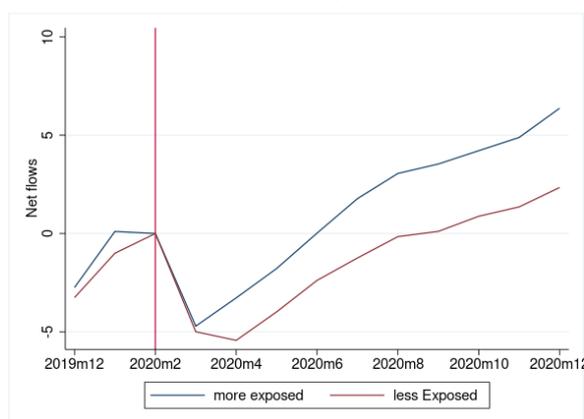


Note. More exposed funds are those with a share of assets eligible for AP-C19 above the median in February 2020; while less exposed ones are funds with a share below the median. The change in the average credit rating of funds' portfolio is expressed in rating points by using a 22-level scale, while the change in the illiquidity measure, based on Roll (1984), is expressed in points.

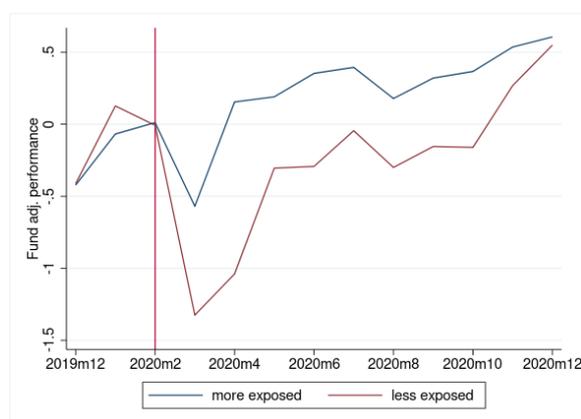
In terms of performances, highly exposed funds' adjusted returns were negative only in March 2020 and remained positive from April to the end of the period examined; in contrast, the returns of low exposed ones significantly dropped in March and remained negative until October. The significant difference in performances between the two groups disappeared at the end of 2020.

Figure 5 – Flows and returns across more and less exposed funds (index: February 2020=0).

a) Cumulative net flows (as percentage of AuM)



b) Adjusted cumulative returns



Note. In both panels more exposed funds are those with a share of assets eligible for AP-C19 above the median in February 2020; while less exposed ones are funds with a share below the median. Cumulative net flows are expressed as percentage of assets under management. Fund adjusted cumulative performances are computed as the cumulative difference between the return of fund f and the median return of the fund's category in each period. They are expressed in percentage points. Fund categories are Europe, International, Mixed, UK, and US.

3.2. Baseline estimates

The increased portfolio risk assessed in the previous section may be driven by two main types of adjustments by fund managers. On the one hand, managers may have actively increased risk-taking, buying riskier securities to increase returns. On the other hand, managers may have passively

increased risk-taking by holding on to securities whose risks have increased due to, for example, the deterioration of the economic outlook for 2020. Distinguishing “active” and “passive” risk-taking is key to understand the behaviour of open-ended bond funds.

In this section we provide a formal analysis of fund risk-taking in 2020 using regression models. We first examine the relationship between fund exposure to AP-C19 and managers’ active risk-taking, as measured by the variable $\Delta Risk$ described in Section 2.3. To this end, we estimate the following empirical model:

$$\Delta Risk_{f,t} = \alpha + \beta Exposure_{f,feb} + \delta Controls_{f,t} + \theta_{t,category} + \mu_{domicile} + \varepsilon_{f,t} \quad (2)$$

The dependent variable is the difference between the average riskiness of the portfolio of fund f in t and that in $t-1$ ($\Delta Rating$ and $\Delta Illiquidity$).¹⁹ The main variable of interest is $Exposure_{f,feb}$, which is the ratio of bonds eligible for CB asset purchase programmes over total assets of fund f in February 2020. We use the pre-pandemic level of exposure to AP-C19 as it is reasonably exogenous within fund category, however we check the robustness of our results to using the one-month lag exposure to AP-C19 (i.e. $Exposure_{f,t-1}$).²⁰ We expect that more exposed funds increased the riskiness of their portfolio relatively more after the implementation of AP-C19 (i.e., β should be significantly negative for $\Delta Rating$ and positive for $\Delta Illiquidity$).

$Controls_{f,t}$ is a matrix of fund characteristics including net flows of fund f in t expressed as a share of fund f 's AuM ($Flows_{f,t}$), and the share of public bonds held by fund f in February 2020 ($PublicShare_{f,feb}$). The former variable allows us to take into account the potential impact of net flows on fund investment strategies, while the latter one controls for the heterogeneity in the investment mandate as some bond funds may invest a relatively large share of their portfolio in sovereign bonds. Table A.1 shows the summary statistics of the main variables adopted in our analyses.

Finally, we add two sets of fixed effects. First, we include month-fund category fixed effects (θ) to control for time-varying observed and unobserved shocks to each category (e.g., news on output, unemployment, and inflation).²¹ Second, we employ fund domicile fixed effects (μ) to take into account idiosyncratic characteristics of the fund industry in each location.

Table 2 shows the estimates for Eq. (2).²² Our results suggest that funds highly exposed to central banks’ interventions increased the riskiness of their portfolios – both in terms of exposure to credit

¹⁹ See Section 2.3 for more details on the construction of this variable.

²⁰ These robustness checks are shown in Table A.2.

²¹ As anticipated in Section 2.2., by relying on Morningstar “Global Category”, we employ five categories based on location of funds’ investments: Europe, International, Mixed, UK, and US.

²² Our results are robust to clustering standard errors at the fund level.

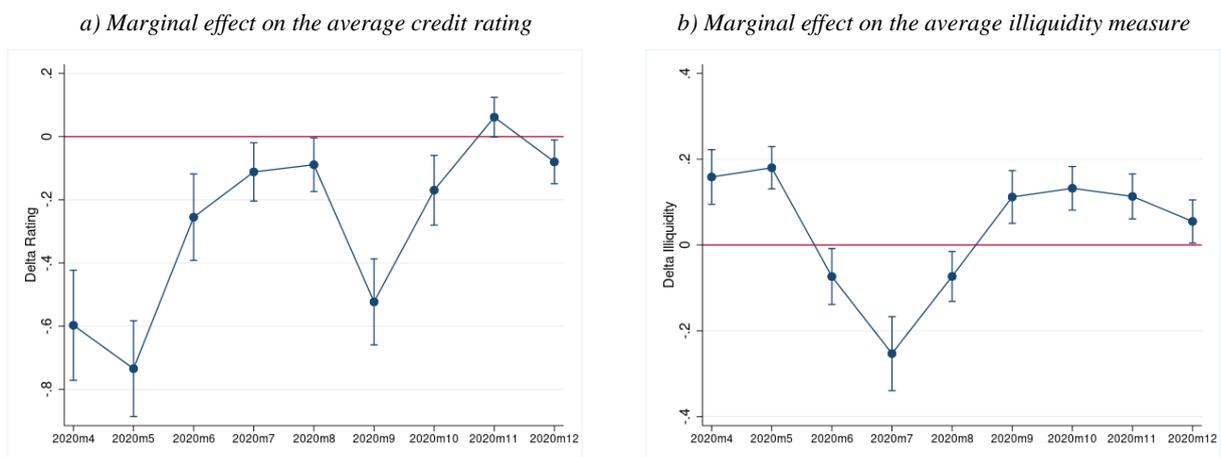
and liquidity risks – more than other intermediaries. The significant coefficients of $Exposure_{feb}$ in both columns suggest that more exposed funds lowered the average rating and liquidity of their portfolios more than less exposed ones. The impact of AP-C19 on funds’ investment strategies is also economically significant: a difference in the exposure equal to the inter-quartile range (i.e. 20 percentage points) is associated with a 0.06 points monthly decrease (i.e. $0.29 \cdot 0.2$) in the average credit rating, equivalent to one fourth of the decline in the average fund portfolio rating observed during 2020, and an average monthly rise in the illiquidity measure of 1.3 points, which is 30 per cent greater than the standard deviation of this variables (equal to 1 by construction) observed in the same period.

Table 2 - Change in risk-taking measures from April to December 2020

	(1)	(2)
	$\Delta Rating$	$\Delta Illiquidity$
$Exposure_{feb}$	-0.2954*** (0.0000)	0.0643** (0.0371)
Constant	-0.2689*** (0.0000)	-0.0252*** (0.0004)
Controls	Yes	Yes
Fund category-time FE	Yes	Yes
Domicile FE	Yes	Yes
Observations	20980	17684
Adj R-squared	0.089	0.050

Note. The table shows the results obtained from the estimation of Eq. (2). The dependent variables are $\Delta Rating$ (column 1), which is the monthly change in the weighted average rating of bonds held by fund f between t and $t-1$, and $\Delta Illiquidity$ (column 2), which is the monthly change in the Roll illiquidity measure of fund f between t and $t-1$. Robust p -values in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Figure 6 – Marginal effect of $Exposure_{feb}$ across months.



Note. Marginal effects are equal to the coefficient of $Exposure_{feb}$ obtained by estimating Eq. (2) for each month.

We also assess whether the impact of AP-C19 on funds’ investment strategies varied across months. Panel (a) of Figure 6 shows the marginal effect of $Exposure_{feb}$ on $\Delta Rating$ across months. The magnitude of the effect of exposures to AP-C19 peaked at May 2020 (i.e. the month immediately

after the beginning of programmes). Afterwards it declined over time, with a smaller resurgence in risk-taking at the end of the third quarter. In particular, during the last nine months of 2020 an increase in the exposure equal to the inter-quartile range led to a cumulative reduction in the average rating of 0.5 rating points (i.e. 3 per cent of the average rating in our sample), more than double of the average decline observed in our sample during the same period. Panel (b) shows that the marginal effect of $Exposure_{feb}$ on $\Delta Illiquidity$ followed a similar trend.

Table 3 - Change in risk-taking measures from April to December 2020

	$\Delta Rating$		$\Delta Illiquidity$	
	(1) Eligible assets	(2) Non-eligible assets	(3) Eligible assets	(4) Non-eligible assets
Exposure _{feb}	0.1056** (0.0190)	-0.4197*** (0.0000)	-0.0657* (0.0730)	0.0417* (0.0718)
Constant	-0.2320*** (0.0000)	-0.2783*** (0.0000)	0.0547*** (0.0003)	-0.0508*** (0.0000)
Controls	Yes	Yes	Yes	Yes
Fund category-time FE	Yes	Yes	Yes	Yes
Domicile FE	Yes	Yes	Yes	Yes
Observations	16349	16349	13375	13375
Adj R-squared	0.103	0.114	0.018	0.082

Note. The table shows the results obtained from the estimation of Eq. (2) by separating the change in the average riskiness on eligible assets (columns 1 and 3) and non-eligible ones (columns 2 and 4). The table excludes funds with no eligible assets. The dependent variables are $\Delta Rating$ (columns 1 and 2), which is the monthly change in the weighted average rating of bonds held by fund f between t and $t-1$, and $\Delta Illiquidity$ (columns 3 and 4), which is the monthly change in the Roll illiquidity measure of fund f between t and $t-1$. Robust p -values in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

To better underscore the economic significance of our results, we calculate the increase of HY bonds in terms of dollar value. This exercise shows that the exposure to AP-C19 is associated with an overall increase of \$107 billion in exposure to HY bonds between April and December 2020,²³ about 23 per cent of the amount of these securities in funds' portfolios at end-February.

Finally, we verify whether the observed increase in risk-taking involved the whole funds' portfolio, the share invested in eligible assets or the share invested in non-eligible assets. In Table 3 we report the results of Eq. (2) by separating the change in the average riskiness on eligible and non-eligible assets.²⁴ Highly exposed funds actively took on more risk by lowering the average rating and increasing the average illiquidity only of non-eligible assets while slightly reducing risk of eligible assets.

²³ First, we compute the increase in the share of HY bonds by estimating the cumulative marginal effect of $Exposure_{feb}$ on $\Delta Share_{HY}$ between April and December and multiplying it for the average exposure to AP-C19 in April. Next, we multiplied this share to the overall amount of assets under management of funds in our sample in April.

²⁴ As underlined in Section 2.2, an unreported robustness check suggests that the share of eligible assets for each fund is quite constant across the considered period.

3.3. Reverse tournaments

In the second step we focus on the effects of AP-C19 on the competition among fund managers. We empirically test our second research question by estimating Eq. (3).

$$\Delta Risk_{f,t} = \alpha + \beta_1 Laggard\ fund_{f,t-1} + \beta_2 HighExposure_{f,feb} + \beta_3 HighExposure_{f,feb} \cdot Laggard\ fund_{f,t-1} + \delta Controls_{f,t} + \theta_{t,category} + \mu_{domicile} + \varepsilon_{f,t} \quad (3)$$

In this analysis we expand Eq. (2) by including *Laggard fund*, which is a dummy variable that takes a value of 1 if the fund's 24 months average risk-adjusted performance is below the median of the distribution of the fund f category in $t-1$.²⁵ We interact this variable with *HighExposure_{feb}*, a dummy variable equal to 1 if fund f 's exposure to AP-C19 in February 2020 was above the median.²⁶ By including this interaction, we investigate whether funds that underperform their peers de-risk less if they are more exposed to AP-C19. Indeed, we expect that underperforming funds should de-risk their portfolios (i.e., β_1 should be positive for $\Delta Rating$ and negative for $\Delta Illiquidity$), as suggested by the literature on reverse tournaments for corporate bond funds (Cutura et al., 2020). However, a high exposure to AP-C19 can interfere with this mechanism by mitigating the need to hold liquid assets to meet redemptions; this, in turn, may reduce the disincentive in engaging reach for yield strategies associated with the general illiquid nature of corporate bonds. We therefore expect β_3 to be negative for $\Delta Rating$ and positive for $\Delta Illiquidity$.

In sum, we examine whether AP-C19 reduces the differences in investment strategies between laggard corporate bond funds and underperforming equity funds (i.e., generally considered as risk-takers under the standard theory of tournaments).

Columns (1) and (2) of Table 4 show the results of this test by adopting respectively $\Delta Rating$ and $\Delta Illiquidity$ as the dependent variable. Consistent with the literature on reverse tournaments, we find that underperforming funds with a low exposure to AP-C19 on average de-risked their portfolios with respect to overperforming ones. Moreover, in line with our hypothesis, the significant coefficients of the interaction *Laggard·HighExposure_{feb}* in both columns suggest that laggard funds de-risked less if they were more exposed to AP-C19. In particular, underperforming and overperforming funds with

²⁵ Consistent with other empirical papers (Cutura et al., 2020; Goldstein et al., 2017), we compute monthly risk-adjusted fund returns (alphas) in a 24-month window. In particular, alpha is estimated as the intercept from a regression of excess corporate bond fund returns on excess aggregate bond market and aggregate stock market returns. We use Vanguard Total Bond Market Index Fund returns and CRSP value-weighted market returns to proxy bond and stock market returns, respectively. As a robustness check, we also consider different thresholds, alternative to the median, to distinguish laggard funds from others.

²⁶ In this model we replace *Exposure_{feb}* with a dummy variable (*HighExposure_{feb}*) in order to ease the interpretation of the interaction with the dummy identifying laggard funds.

an high exposure increased their exposure to liquidity risk almost at the same rate as the difference between the coefficient of *Laggard* and that of *Laggard·HighExposure_{feb}* is approximately zero in column (2).

Table 4 – Change in risk-taking measures from April to December 2020 by comparing overperforming and underperforming funds

	Reverse tournaments	
	(1)	(2)
	$\Delta Rating$	$\Delta Illiquidity$
Laggard	0.0689*** (0.0000)	-0.0489*** (0.0004)
HighExposure _{feb}	-0.1070*** (0.0000)	-0.0127 (0.3040)
Laggard·HighExposure _{feb}	-0.0428** (0.0163)	0.0445*** (0.0042)
Constant	-0.2781*** (0.0000)	0.0085 (0.5332)
Controls	Yes	Yes
Fund category-time FE	Yes	Yes
Domicile FE	Yes	Yes
Observations	20980	17684
Adj R-squared	0.096	0.051

Note. Columns (1) and (2) show the results obtained from the estimation of Eq. (3). The dependent variables are $\Delta Rating$ (column 1), which is the monthly change in the weighted average rating of bonds held by fund *f* between *t* and *t-1*, and $\Delta Illiquidity$ (column 2), which is the monthly change in the Roll illiquidity measure of fund *f* between *t* and *t-1*. Robust *p*-values in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

3.4. Identification issues

A main identification issue in our empirical framework is that the investment strategies of funds more exposed to AP-C19 may be structurally different than those adopted by less exposed intermediaries. The summary statistics reported in Section 3.1 partly attenuate this concern, suggesting that before the pandemic outbreak more exposed funds were on average less risky than less exposed funds.

We present a test that specifically address sample selection issues. Following Falato et al. (2021), we refine the analysis exploiting the maturity threshold employed in the FED asset purchase programme by distinguishing FED eligible bonds with a 5-year maturity (eligible) and bonds with a 6-year maturity that would have been otherwise eligible for FED purchases (quasi-eligible). We use this maturity threshold to construct a group of treated funds (i.e. those that are in the top quartile of exposure to eligible bonds for FED purchases with maturity between 4 and 5 years) and a group of control funds (i.e. those that are in the top quartile of exposure to quasi-eligible bonds for FED purchases, i.e. investment grade bonds with maturity between 5 and 6 years). With this approach, treated and control funds hold similar assets (those eligible or quasi-eligible for FED purchases), although with slightly different maturities. In this test we verify whether treated funds have adopted

different investment strategies than control ones by replacing $Exposure_{feb}$ with $Treated$, a dummy variable equal to 1 for funds in the treated group and to 0 if the fund is in the control group.

The results of this test, reported in Table 5, imply that the monthly reduction in the credit quality of treated funds is about 22 per cent larger than the one of control funds (-0.0870/-0.4026; see column 1). Similarly, treated funds lowered their illiquidity measure about the half than control ones (0.059/-0.1472; see column 2).

Also the sample of laggard funds may be affected by the selection bias. Therefore, we repeat the same robustness check to address this concern. In this case, we estimate Eq. (3) by focusing on the difference between treated laggard funds (i.e. those that are in the top third of exposure to eligible bonds) and control laggard funds (i.e. those that are in the top third of exposure to quasi-eligible bonds).²⁷ The results of this test, reported in columns (3) and (4) of Table 5, confirm our main findings.

Table 5 – Sample selection test

	Baselines estimates		Reverse tournaments	
	(1)	(2)	(3)	(4)
	$\Delta Rating$	$\Delta Illiquidity$	$\Delta Rating$	$\Delta Illiquidity$
Treated	-0.0870** (0.0042)	0.0590** (0.0418)	-0.0746*** (0.0012)	0.0641** (0.0205)
Constant	-0.4026*** (0.0000)	-0.1472*** (0.0000)	-0.3204*** (0.0000)	-0.0984*** (0.0005)
Controls	Yes	Yes	Yes	Yes
Fund category-time FE	Yes	Yes	Yes	Yes
Domicile FE	Yes	Yes	Yes	Yes
Observations	2100	1678	2218	1853
Adj R-squared	0.093	0.050	0.117	0.032

Note. Columns (1) and (2) show the results obtained from the estimation of Eq. (2) by replacing $Exposure_{feb}$ with $Treated$ and focusing on the sample of treated and control funds. Columns (3) and (4) report the results of Eq. (3) estimated by replacing $HighExposure_{feb}$ with $Treated$ and focusing on the sample of treated and control laggard funds included in the group of laggard funds. The dependent variables are $\Delta Rating$ (columns 1 and 3), which is the monthly change in the weighted average rating of bonds held by fund f between t and $t-1$, and $\Delta Illiquidity$ (columns 2 and 4), which is the monthly change in the Roll illiquidity measure of fund f between t and $t-1$. Robust p -values in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

3.5. Risk-taking of more fragile funds

In this section we examine whether the impact of AP-C19 was heterogeneous across fund characteristics by focusing on the investment strategies of funds that were more fragile before the beginning of central banks' interventions.

The measurement of fund fragility may rely on several measures (Falato et al., 2021), in our framework we focus on funds with more risky and less liquid assets. Since the transaction costs for these securities were significant during the pandemic crisis, when market liquidity dried up, payoff

²⁷ In this test we lower the threshold for the identification of treated and control funds (i.e. from the top quartile to the top third of the distribution) in order to focus on a number of funds comparable to the model reported in columns 1 and 2.

complementarities among investors were higher for more fragile funds. As argued in the introduction, since AP-C19 reduced liquidation costs in the corporate bond market, more fragile funds that were also highly exposed to programmes may have particularly benefited from these interventions. AP-C19 may have allowed highly exposed fragile funds to take more risk than low exposed fragile intermediaries.

To identify more fragile funds, we compute the share of high yield bonds ($ShareHY_{f,feb}$), which are generally the riskiest bonds, and their average Roll illiquidity measure at the end of February ($Illiquidity_{f,feb}$), immediately before the pandemic outbreak. Higher is the value of both measures, greater is the degree of fund fragility.

Table 6 - Change in risk-taking by focusing on more fragile funds

	(1)	(2)
	$\Delta Rating$	$\Delta Illiquidity$
Exposure _{feb}	-0.1551*** (0.0038)	-0.0979* (0.0576)
ShareHY _{feb}	0.1194*** (0.0000)	-
Illiquidity _{feb}	-	-0.0731*** (0.0000)
Exposure _{feb} ·ShareHY _{feb}	-0.6366*** (0.0099)	-
Exposure _{feb} ·Illiquidity _{feb}	-	0.0542** (0.0357)
Constant	-0.3156*** (0.0000)	0.0963*** (0.0004)
Controls	Yes	Yes
Fund category-time FE	Yes	Yes
Domicile FE	Yes	Yes
Observations	20980	17660
Adj R-squared	0.091	0.085

Note. The table shows the results obtained from the estimation of Eq. (2) by including an interaction between Exposure_{feb} and ShareHY_{feb} (column 1) and Illiquidity_{feb} (column 2). The dependent variables are $\Delta Rating$ (column 1), which is the monthly change in the weighted average rating of bonds held by fund f between t and $t-1$, and $\Delta Illiquidity$ (column 2), which is the monthly change in the Roll illiquidity measure of fund f between t and $t-1$. Robust p -values in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Columns (1) and (2) of Table 6 show the results of Eq. (2) estimated by interacting Exposure_{f,feb} with ShareHY_{f,feb} and Illiquidity_{f,feb}. As expected, the interacted coefficients suggest that the exposure to AP-C19 had a significant impact on fragile funds' investment strategies. Indeed, for a given share of high yield bonds or a given average portfolio liquidity in February, funds more exposed to AP-C19 de-risked less than less exposed ones. Consistent with Falato et al. (2021), the positive coefficient of ShareHY_{f,feb} and the negative one of Illiquidity_{f,feb} imply that a higher degree of fragility is associated with an increasing de-risking of fund portfolios, suggesting that payoff complementarities among investors reduce funds' incentives to take more risk in the aftermath of market stress.

4. Conclusions

Corporate bond funds have become an important source of credit to the economy, highlighting the need to improve our understanding of their incentives and vulnerabilities. This paper shows that the interaction between financial fragilities associated to liquidity mismatch in the corporate bond market and the introduction of central banks' purchase programmes was a key driver of bond funds' risk-taking after the outbreak of the COVID-19 shock. Central banks' interventions aimed at restoring market functioning successfully reduced liquidity costs in the corporate bond market. The decline in transaction costs reduced strategic complementarities among investors in bond funds, which may have potentially reinforced asset managers' willingness to hold riskier assets in order to increase fund returns.

Our empirical analysis confirms this interpretation. We show that funds with higher exposure to central banks' purchase programmes increased both credit and liquidity risks of their portfolios more than their peers with lower exposure. Highly exposed funds took on risk by reducing the average rating and liquidity of non-eligible assets while slightly reducing these risks on the eligible portion of their portfolios.

Analysing the rank-chasing (tournament) behavior of corporate bond mutual funds, we find that funds with higher exposure to eligible bonds increased the riskiness of their portfolio, rather than reducing it, when they underperformed their peers. This suggests that the reduction in transaction costs in the corporate bond market associated with the implementation of central banks' policy measures has also strengthened the rank-chasing behaviour of corporate bond funds.

Finally, we show that more fragile funds (i.e. those with higher pre-pandemic shares of HY bonds or less liquid portfolios) increased the riskiness of their portfolios less than their more resilient peers in the aftermath of the crisis, suggesting that strategic complementarities among investors can deter fund risk-taking in the aftermath of market stress. However, consistent with our main findings, fragile funds more exposed to AP-C19 de-risked to a more limited extent than the less exposed ones. These results are robust to potential identification issues.

Our analysis provides several policy implications. Central bank interventions have been effective in restoring market functioning and addressing systemic risks in the aftermath of the COVID-19 outbreak. The benefits of these measures were not limited to eligible assets but, via the increased purchases by highly exposed funds, could have been also transmitted to not eligible securities, such as high yield bonds ("bond fund channel"). However, as we show, such interventions, by mitigating the risk of investors' runs, may have unintendedly strengthened funds' risk-taking incentives. It can be the case that in future periods of extreme market stress, some forms of external support will again be provided by central banks. Our results suggest that these interventions may be associated with an

excessive build-up of risks in the bond fund sector. These unintended effects may be addressed by carefully designing policies that mitigate ex-ante risk-taking of bond funds (Giuzio et al., 2021). Increasing the resilience of the sector by preventing the build-up of vulnerabilities, in turn, would support the effective transmission of monetary policy and could also limit central bank interventions in times of crisis (ECB, 2021).

Going forward, a comprehensive assessment of the pros and cons associated with different forms of external support should be carried out; also, reflection is needed on whether current regulation on investment funds is sufficient to address systemic risks that may arise from excessive risk-taking.

Finally, extending these results by understanding the impact of policy measures on the optimal allocation of funds' portfolios and on the behavior of other intermediaries, such as banks, insurers and pension funds are interesting avenues for future research.

References

- Affinito, M., Santioni, R., 2021. When the panic broke out: Covid-19 and investment funds' portfolio rebalancing around the world, Temi di Discussione (Working Papers), Bank of Italy.
- Bao, J., O'Hara, M., (Alex) Zhou, X., 2018. The Volcker Rule and corporate bond market making in times of stress. *Journal of Financial Economics* 130, 95–113.
- Becker, B., Ivashina, V., 2015. Reaching for Yield in the Bond Market. *Journal of Finance* 70, 1863–1902.
- Becker, B., Ivashina, V., 2014. Cyclicalities of credit supply: Firm level evidence. *Journal of Monetary Economics* 62, 76–93.
- BIS, 2021. A global database on central banks' monetary responses to Covid-19. URL: <https://www.bis.org/publ/work934.htm>
- Boyarchenko, N., Kovner, A., Shachar, O., 2022. It's What You Say and What You Buy: A Holistic Evaluation of the Corporate Credit Facilities, Working Paper.
- Breckenfelder, J., Grimm, N., Hoerova, M., 2021. Do Non-Banks Need Access to the Lender of Last Resort? Evidence from Mutual Fund Runs, Working Paper.
- Chen, Y., Ferson, W., Peters, H., 2010. Measuring the timing ability and performance of bond mutual funds. *Journal of Financial Economics* 98, 72–89.
- Chernenko, S., Sunderam, A., 2020. Measuring the Perceived Liquidity of the Corporate Bond Market, NBER Working paper.
- Choi, J., Kronlund, M., 2018. Reaching for yield in corporate bond mutual funds. *Review of Financial Studies* 31, 1930–1965.
- Cici, G., Gibson, S., Merrick, J.J., 2011. Missing the marks? Dispersion in corporate bond valuations across mutual funds. *Journal of Financial Economics* 101, 206–226.
- Cutura, J., Parise, G., Schrimpf, A., 2020. Debt De-risking, BIS Working Paper.
- ECB, 2021. Non-Bank Financial Intermediation in the Euro Area: Implications for Monetary Policy Transmission and Key Vulnerabilities, Occasional Paper.
- Edwards, A.K., Harris, L.E., Piwowar, M.S., 2007. Corporate bond market transaction costs and transparency. *Journal of Finance* 62, 1421–1451.
- Falato, A., Goldstein, I., Hortaçsu, A., 2021. Financial Fragility in the COVID-19 Crisis: The Case

- of Investment Funds in Corporate Bond Markets. *Journal of Monetary Economics* 123, 35–52.
- Feroli, M., Kashyap, A.K., Schoenholtz, K.L., Shin, H.S., 2014. Market Tantrums and Monetary Policy, Working Paper.
- FSB, 2017. Policy Recommendations to Address Structural Vulnerabilities from Asset Management Activities.
- FSB, 2020. Holistic Review of the March Market Turmoil.
- Giuzio, M., Kaufmann, C., Ryan, E., Cappiello, L., 2021. Investment funds, risk-taking, and monetary policy in the euro area, ECB Working Paper.
- Goldstein, I., Jiang, H., Ng, D.T., 2017. Investor flows and fragility in corporate bond funds. *Journal of Financial Economics* 126, 592–613.
- Haddad, V., Moreira, A., Muir, T., 2021. When Selling Becomes Viral: Disruptions in Debt Markets in the Covid-19 Crisis and the Fed’s Response. *The Review of Financial Studies* 34, 5309–5351.
- Kacperczyk, M., Schnabl, P., 2015. How safe are money market funds? *Quarterly Journal of Economics* 128, 1073–1122.
- Kargar, M., Lester, B., Lindsay, D., Liu, S., Weill, P.-O., Zúñiga, D., 2021. Corporate Bond Liquidity during the COVID-19 Crisis. *The Review of Financial Studies* 34, 5352–5401.
- Lazear, E.P., Rosen, S., 1981. Rank-Order Tournaments as Optimum Labor Contracts. *Journal of Political Economy* 5.
- Ma, Y., Xiao, K., Zeng, Y., 2022. Mutual Fund Liquidity Transformation and Reverse Flight to Liquidity. *The Review of Financial Studies* Forthcoming.
- Manconi, A., Massa, M., Yasuda, A., 2012. The role of institutional investors in propagating the crisis of 2007-2008. *Journal of Financial Economics* 104, 491–518.
- O’Hara, M., Zhou, X. (Alex), 2021. Anatomy of a Liquidity Crisis: Corporate Bonds in the COVID-19 Crisis. *Journal of Financial Economics* 142, 46–68.
- Roll, R., 1984. A Simple Implicit Measure of the Effective Bid-Ask Spread in an Efficient Market. *The Journal of Finance* 39, 1127–1139.
- Simutin, M., 2014. Cash holdings and mutual fund performance. *Review of Finance* 18, 1425–1464.
- Strahan, P., Tanyeri, B., 2015. Once burned, twice shy: money market fund responses to a systemic liquidity shock. *Journal of Financial and Quantitative Analysis* 50, 119–144.

Appendix

Figure A.1 – Asset under management composition of funds included in the analysis (as of February 2020)

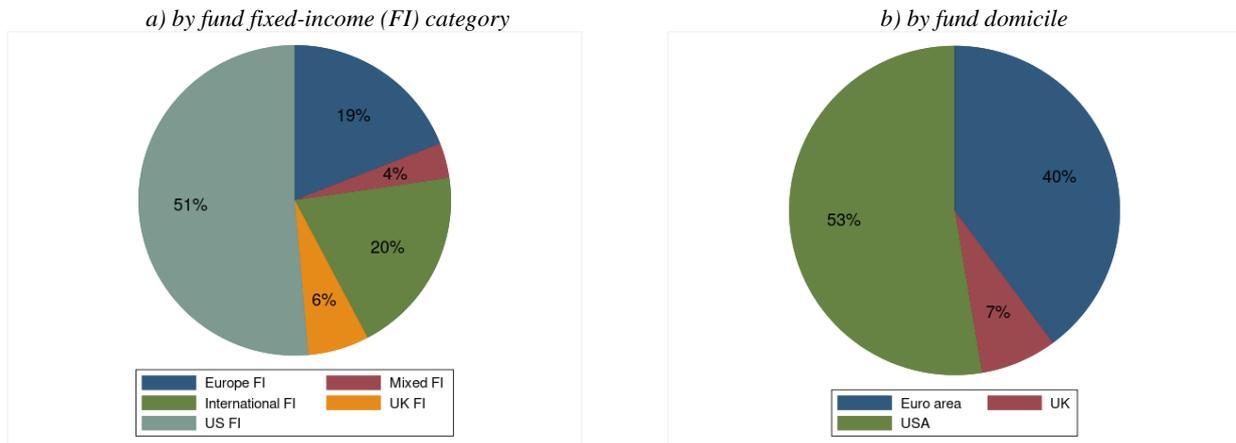


Figure A.2 – Composition of eligible assets by central bank program (as of February 2020)

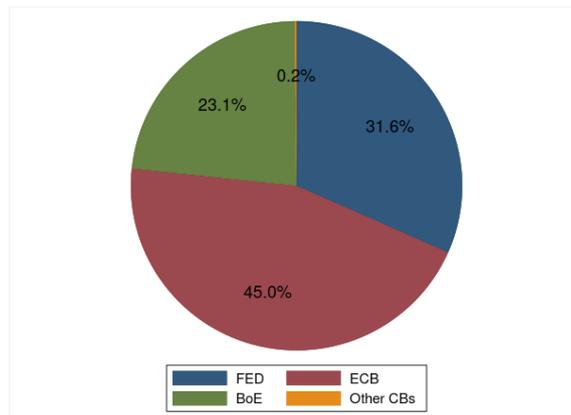


Table A.1 – Summary statistics

	Mean	P25	Median	P75	SD
Δ Rating	-0.25	-0.36	-0.11	0.00	0.52
Δ Illiquidity	0.00	-0.06	0.07	0.11	1.00
Δ ShareHY	-1.61	-0.01	0.00	0.00	9.26
Δ Yield	-0.37	-0.02	0.05	0.02	10.40
Δ Maturity	1.06	-0.30	0.58	2.17	73.76
Exposure _{feb}	13.16	0.00	6.04	0.23	15.93
Flows	0.59	-0.99	0.00	1.55	6.66
PublicShare	27.49	0.00	7.03	50.00	34.66

Table A.2 – Results with time-varying exposures and by program

	(1)	(2)	(3)	(4)	(5)
	Δ Rating	Δ ShareHY	Δ Yield	Δ Maturity	PCA
Exposure _{feb}	-	0.0641*** (0.0000)	0.0130* (0.0527)	-2.5312 (0.7854)	0.7276*** (0.0000)
Exposure _{t-1}	-0.3176*** (0.0000)	-	-	-	-
Constant	-0.2660*** (0.0000)	-0.0318*** (0.0000)	-0.0100*** (0.0000)	1.6739 (0.2055)	-0.0726*** (0.0000)
Controls	Yes	Yes	Yes	Yes	Yes
Fund category-time FE	Yes	Yes	Yes	Yes	Yes
Domicile FE	Yes	Yes	Yes	Yes	Yes
Observations	20980	19367	17691	17682	17648
Adj R-squared	0.092	0.061	0.016	0.003	0.094

Note. Column (1) shows the results obtained from the estimation of Eq. (2) by replacing Exposure_{feb} with Exposure_{t-1}, which is the share of bonds eligible for CB asset purchase programmes held by fund *f* in *t-1*. The dependent variable is Δ Rating, which is the monthly change in the weighted average rating of bonds held by fund *f* between *t* and *t-1*. Columns (2)-(5) present the results of Eq. (2) estimated by using as the dependent variable: Δ ShareHY, Δ Yield, Δ Maturity, and the principal component of the measures relating to credit risk, respectively. Robust *p*-values in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

RECENTLY PUBLISHED “TEMI” (*)

- N. 1383 – *Bank lending to small firms: metamorphosis of a financing model*, by Paolo Finaldi Russo, Valentina Nigro and Sabrina Pastorelli (October 2022).
- N. 1384 – *Macroeconomic effects of growth-enhancing measures in the euro area*, by Alessandro Cantelmo, Alessandro Notarpietro and Massimiliano Pisani (October 2022).
- N. 1385 – *Revisiting the real exchange rate misalignment-economic growth nexus via the across-sector misallocation channel*, by Claire Giordano (October 2022).
- N. 1386 – *Labor market spillovers of a large plant opening. Evidence from the oil industry*, by Matteo Alpino, Irene Di Marzio, Maurizio Lozzi and Vincenzo Mariani (October 2022).
- N. 1387 – *Unburdening regulation: the impact of regulatory simplification on photovoltaic adoption in Italy*, by Federica Daniele, Alessandra Pasquini, Stefano Clò and Enza Maltese (October 2022).
- N. 1388 – *Liberalizing the opening of new pharmacies and hospitalizations*, by Andrea Cintolesi and Andrea Riganti (November 2022).
- N. 1389 – *Mediation Analysis Synthetic Control*, by Giovanni Mellace and Alessandra Pasquini (November 2022).
- N. 1390 – *The effects of partial employment protection reforms: evidence from Italy*, by Diego Daruich, Sabrina Di Addario and Raffaele Saggio (November 2022).
- N. 1391 – *The role of majority status in close election studies*, by Matteo Alpino and Marta Crispino (November 2022).
- N. 1392 – *Issuing bonds during the Covid-19 pandemic: is there an ESG premium?*, by Fabrizio Ferriani (November 2022).
- N. 1393 – *Economic fundamentals and stock market valuation: a CAPE-based approach*, by Maria Ludovica Drudi and Federico Calogero Nucera (November 2022).
- N. 1394 – *The impact of “Metro C” in Rome on the housing market*, by Federica Daniele and Elena Romito (December 2022).
- N. 1395 – *Gender quotas, board diversity and spillover effects. Evidence from Italian banks*, by Silvia Del Prete, Giulio Papini and Marco Tonello (December 2022).
- N. 1396 – *Real-time inequalities and policies during the pandemic in the US*, by Luisa Corrado, Daniela Fantozzi and Simona Giglioli (December 2022).
- N. 1397 – *The impact of sovereign tensions on bank lending: identifying the channels at work*, by Fabiana Sabatini (December 2022).
- N. 1398 – *Make-up strategies and exchange rate pass-through in a low-interest-rate environment*, by Alessandro Cantelmo, Pietro Cova, Alessandro Notarpietro and Massimiliano Pisani (December 2022).
- N. 1399 – *Measuring peer effects in parental leaves: evidence from a reform*, by Davide Dottori, Francesca Modena and Giulia Martina Tanzi (February 2023).
- N. 1400 – *Firms’ innovation and university cooperation. New evidence from a survey of Italian firms*, by Daniela Bragoli, Flavia Cortelezzi and Massimiliano Rigon (February 2023).
- N. 1401 – *Schools and the transmission of Sars-Cov-2: evidence from Italy*, by Salvatore Lattanzio (February 2023).
- N. 1402 – *Remittances in times of crisis: evidence from Italian corridors*, by Alessio Ciarlone (February 2023).
- N. 1403 – *EU banks’ dividend policies: main determinants and the role of capital ratios*, by Salvatore Cardillo and Jacopo Raponi (February 2023).

(*) Requests for copies should be sent to:

Banca d’Italia – Servizio Studi di struttura economica e finanziaria – Divisione Biblioteca e Archivio storico – Via Nazionale, 91 – 00184 Rome – (fax 0039 06 47922059). They are available on the Internet www.bancaditalia.it.

2020

- ALESSANDRI P. and M. BOTTERO, *Bank lending in uncertain times*, R European Economic Review, V. 128, **WP 1109 (April 2017)**.
- ANTUNES A. and V. ERCOLANI, *Public debt expansions and the dynamics of the household borrowing constraint*, Review of Economic Dynamics, v. 37, pp. 1-32, **WP 1268 (March 2020)**.
- ARDUINI T., E. PATACCHINI and E. RAINONE, *Treatment effects with heterogeneous externalities*, Journal of Business & Economic Statistics, v. 38, 4, pp. 826-838, **WP 974 (October 2014)**.
- BALTRUNAITE A., C. GIORGIANTONIO, S. MOCETTI and T. ORLANDO, *Discretion and supplier selection in public procurement*, Journal of Law, Economics, and Organization, v. 37, 1, pp. 134-166, **WP 1178 (June 2018)**.
- BOLOGNA P., A. MIGLIETTA and A. SEGURA, *Contagion in the CoCos market? A case study of two stress events*, International Journal of Central Banking, v. 16, 6, pp. 137-184, **WP 1201 (November 2018)**.
- BOTTERO M., F. MEZZANOTTI and S. LENZU, *Sovereign debt exposure and the Bank Lending Channel: impact on credit supply and the real economy*, Journal of International Economics, v. 126, article 103328, **WP 1032 (October 2015)**.
- BRIPI F., D. LOSCHIAVO and D. REVELLI, *Services trade and credit frictions: evidence with matched bank – firm data*, The World Economy, v. 43, 5, pp. 1216-1252, **WP 1110 (April 2017)**.
- BRONZINI R., G. CARAMELLINO and S. MAGRI, *Venture capitalists at work: a Diff-in-Diff approach at late-stages of the screening process*, Journal of Business Venturing, v. 35, 3, **WP 1131 (September 2017)**.
- BRONZINI R., S. MOCETTI and M. MONGARDINI, *The economic effects of big events: evidence from the Great Jubilee 2000 in Rome*, Journal of Regional Science, v. 60, 4, pp. 801-822, **WP 1208 (February 2019)**.
- COIBION O., Y. GORODNICHENKO and T. ROPELE, *Inflation expectations and firms' decisions: new causal evidence*, Quarterly Journal of Economics, v. 135, 1, pp. 165-219, **WP 1219 (April 2019)**.
- CORSELLO F. and V. NISPI LANDI, *Labor market and financial shocks: a time-varying analysis*, Journal of Money, Credit and Banking, v. 52, 4, pp. 777-801, **WP 1179 (June 2018)**.
- COVA P. and F. NATOLI, *The risk-taking channel of international financial flows*, Journal of International Money and Finance, v. 102, **WP 1152 (December 2017)**.
- D'ALESSIO G., *Measurement errors in survey data and the estimation of poverty and inequality indices*, Statistica Applicata - Italian Journal of Applied Statistics, v. 32, 3, **WP 1116 (June 2017)**.
- DE BLASIO G., I. DE ANGELIS and L. RIZZICA, *Lost in corruption. Evidence from EU funding to Southern Italy*, Italian Economic Journal / Rivista italiana degli economisti, v. 6, 3, pp. 355–377, **WP 1180 (December 2016)**.
- DEL PRETE S. and S. FEDERICO, *Do links between banks matter for bilateral trade? Evidence from financial crises*, Review of World Economic, v. 156, 4, pp. 859 - 885, **WP 1217 (April 2019)**.
- D'IGNAZIO A. and C. MENON, *The causal effect of credit Guarantees for SMEs: evidence from Italy*, The Scandinavian Journal of Economics, v. 122, 1, pp. 191-218, **WP 900 (February 2013)**.
- ERCOLANI V. and F. NATOLI, *Forecasting US recessions: the role of economic uncertainty*, Economics Letters, v. 193, **WP 1299 (October 2020)**.
- MAKINEN T., L. SARNO and G. ZINNA, *Risky bank guarantees*, Journal of Financial Economics, v. 136, 2, pp. 490-522, **WP 1232 (July 2019)**.
- MODENA F., E. RETTORE and G. M. TANZI, *The effect of grants on university dropout rates: evidence from the Italian case*, Journal of Human Capital, v. 14, 3, pp. 343-370, **WP 1193 (September 2018)**.
- NISPI LANDI V., *Capital controls spillovers*, Journal of International Money and Finance, v. 109, **WP 1184 (July 2018)**.
- PERICOLI M., *On risk factors of the stock–bond correlation*, International Finance, v. 23, 3, pp. 392-416, **WP 1198 (November 2018)**.
- PIETRUNTI M. and F. M. SIGNORETTI, *Unconventional monetary policy and household debt: the role of cash-flow effects*, Journal of Macroeconomics, v. 64, Article 103201, **WP 1142 (October 2017)**.
- RAINONE E., *The network nature of OTC interest rates*, Journal of Financial Markets, v.47, article 100525, **WP 1022 (July 2015)**.
- RAINONE E. and F. VACIRCA, *Estimating the money market microstructure with negative and zero interest rates*, Quantitative Finance, v. 20, 2, pp. 207-234, **WP 1059 (March 2016)**.
- RIZZICA L., *Raising aspirations and higher education. Evidence from the UK's widening participation policy*, Journal of Labor Economics, v. 38, 1, pp. 183-214, **WP 1188 (September 2018)**.
- RIZZICA L. and M. TONELLO, *Persuadable perceptions: the effect of media content on beliefs about corruption*, Economic Policy, v. 35, 104, pp. 679–737, **WP 1043 (November 2016)**.

- SANTIONI, R., F. SCHIANTARELLI and P. STRAHAN, *Internal capital markets in times of crisis: the benefit of group affiliation*, *Review of Finance*, v. 24, 4, pp. 773-811, **WP 1146 (October 2017)**.
- SCHIANTARELLI F., M. STACCHINI and P. STRAHAN, *Bank Quality, judicial efficiency and loan repayment delays in Italy*, *Journal of Finance*, v. 75, 4, pp. 2139-2178, **WP 1072 (July 2016)**.

2021

- ACCETTURO A., A. LAMORGESE, S. MOCETTI and D. PELLEGRINO, *Housing Price elasticity and growth: evidence from Italian cities*, *Journal of Economic Geography*, v. 21, 3, pp. 367-396, **WP 1267 (March 2020)**.
- AFFINITO M. and M. PIAZZA, *Always look on the bright side? Central counterparties and interbank markets during the financial crisis*, *International Journal of Central Banking*, v. 17, 1, pp. 231-283, **WP 1181 (July 2018)**.
- ALBANESE G., E. CIANI and G. DE BLASIO, *Anything new in town? The local effects of urban regeneration policies in Italy*, *Regional Science and Urban Economics*, v. 86, **WP 1214 (April 2019)**.
- ALBANESE G., G. DE BLASIO and A. LOCATELLI, *Does EU regional policy promote local TFP growth? Evidence from the Italian Mezzogiorno*, *Papers in Regional Science*, v. 100, 2, pp. 327-348, **WP 1253 (December 2019)**.
- ALBERTAZZI A., A. NOBILI and F. M. SIGNORETTI, *The bank lending channel of conventional and unconventional monetary policy*, *Journal of Money, Credit and Banking*, v. 53, 2-3, pp. 261-299, **WP 1094 (Jan 2017)**.
- ANZUINI A. and L. ROSSI, *Fiscal policy in the US: a new measure of uncertainty and its effects on the American economy*, *Empirical Economics*, v. 61, 6, pp. 2613-2634, **WP 1197 (November 2018)**.
- APRIGLIANO V. and D. LIBERATI, *Using credit variables to date business cycle and to estimate the probabilities of recession in real time*, *The Manchester School*, v. 89, 51, pp. 76-96, **WP 1229 (July 2019)**.
- AUER S., M. BERNARDINI and M. CECIONI, *Corporate leverage and monetary policy effectiveness in the euro area*, *European Economic Review*, v. 140, Article 103943, **WP 1258 (December 2019)**.
- BANERJEE R, L. GAMBACORTA and E. SETTE, *The real effects of relationship lending*, *Journal of Financial Intermediation*, v. 48, Article 100923, **WP 1133 (September 2017)**.
- BARONE G., F. DAVID, G. DE BLASIO and S. MOCETTI, *How do house prices respond to mortgage supply?*, *Journal of Economic Geography*, v. 21, 1, pp. 127-140, **WP 1282 (June 2020)**.
- BARONE G. and S. MOCETTI, *Intergenerational mobility in the very long run: Florence 1427-2011*, *Review of Economic Studies*, v. 88, 4, pp. 1863-1891, **WP 1060 (April 2016)**.
- BARTOCCI A., L. BURLON, A. NOTARPIETRO and M. PISANI, *Macroeconomic effects of non-standard monetary policy measures in the Euro Area: the role of corporate bond purchases*, *The Manchester School*, v. 89, S1, pp. 97-130, **WP 1241 (October 2019)**.
- BATINI N., A. CANTELMO, G. MELINA and S. VILLA, *How loose, how tight? A measure of monetary and fiscal stance for the euro area*, *Oxford Economic Papers*, v. 73, 4, pp. 1536-1556, **WP 1295 (September 2020)**.
- BENETTON M. and D. FANTINO, *Targeted monetary policy and bank lending behavior*, *Journal of Financial Economics*, v. 142, 1, pp. 404-429, **WP 1187 (September 2018)**.
- BUSETTI F., M. CAIVANO and D. DELLE MONACHE, *Domestic and global determinants of inflation: evidence from expectile regression*, *Oxford Bulletin of Economics and Statistics*, v. 83, 4, pp. 982-1001, **WP 1225 (June 2019)**.
- BUSETTI F., M. CAIVANO, D. DELLE MONACHE and C. PACELLA, *The time-varying risk of Italian GDP*, *Economic Modelling*, v. 101, Article 105522, **WP 1288 (July 2020)**.
- BUSETTI F., S. NERI, A. NOTARPIETRO and M. PISANI, *Monetary Policy strategies in the new normal: a model-based analysis for the Euro Area*, *Journal of Macroeconomics*, v. 70, Article 103366, **WP 1308 (December 2020)**.
- CAPOLONGO A. and C. PACELLA, *Forecasting inflation in the Euro Area: countries matter*, *Empirical Economics*, v. 61, 4, pp. 2477-2499, **WP 1224 (June 2019)**.
- CARMIGNANI A., G. DE BLASIO, C. DEMMA and A. D'IGNAZIO, *Urbanization and firm access to credit*, *Journal of Regional Science*, v. 61, 3, pp. 597-622, **WP 1222 (June 2019)**.
- CORNELI F., *Financial integration without financial development*, *Atlantic Economic Journal*, v. 49, 2, pp. 201-220, **WP 1120 (June 2017)**.
- COVA P., P. PAGANO, A. NOTARPIETRO and M. PISANI, *Secular stagnation, R&D, public investment and monetary policy: a global-model perspective*, *Macroeconomic Dynamics*, v. 25, 5, pp. 1267-1287, **WP 1156 (December 2017)**.
- DE PHILIPPIS M., *Multitask agents and incentives: the case of teaching and research for university professors*, *Economic Journal*, v. 131, 636, pp. 1643-1681, **WP 1042 (December 2015)**.

- DEL PRETE S. and M. L. STEFANI, *Women as "Gold Dust": gender diversity in top boards and the performance of Italian banks*, Economic Notes, Monte dei Paschi di Siena, v. 50, 2, e12183, **WP 1014 (June 2015)**.
- FERRERO G., M. LOBERTO and M. MICCOLI, *The assets' pledgeability channel of unconventional monetary policy*, Economic Inquiry, v. 59, 4, pp. 1547-1568, **WP 1119 (June 2017)**.
- FIDORA M., C. GIORDANO and M. SCHMITZ, *Real exchange rate misalignments in the Euro Area*, Open Economies Review, v. 32, 1, pp. 71-107, **WP 1162 (January 2018)**.
- GAMBACORTA L., G. RICOTTI, S. SUNDARESAN and Z. WANG, *Tax effects on bank liability structure*, European Economic Review, v. 138, Article 103820, **WP 1101 (February 2017)**.
- HERTWECK M., V. LEWIS and S. VILLA, *Going the extra mile: effort by workers and job-seekers*, Journal of Money, Credit and Banking, v. 54, 8, pp. 2099-2127, **WP 1277 (June 2020)**.
- LI F., A. MERCATANTI, T. MAKINEN and A. SILVESTRINI, *A regression discontinuity design for ordinal running variables: evaluating central bank purchases of corporate bonds*, The Annals of Applied Statistics, v. 15, 1, pp. 304-322, **WP 1213 (March 2019)**.
- LOSCHIAVO D., *Big-city life (dis)satisfaction? The effect of urban living on subjective well-being*, Journal of Economic Behavior & Organization, vol. 192, pp. 740-764, **WP 1221 (June 2019)**.
- LOSCHIAVO D., *Household debt and income inequality: evidence from Italian survey data*, Review of Income and Wealth, v. 67, 1, pp. 61-103, **WP 1095 (January 2017)**.
- METELLI L. and F. NATOLI, *The international transmission of US tax shocks: a proxy-SVAR approach*, IMF Economic Review, v. 69, 2, pp. 325-356, **WP 1223 (June 2019)**.
- NISPI LANDI V. and A. SCHIAVONE, *The effectiveness of capital controls*, Open Economies Review, v. 32, 1, pp. 183-211, **WP 1200 (November 2018)**.
- PAPETTI A., *Demographics and the natural real interest rate: historical and projected paths for the Euro Area*, Journal of Economic Dynamics and Control, v. 132, Article 04209, **WP 1306 (November 2020)**.
- PEREDA FERNANDEZ S., *Copula-based random effects models for clustered data*, Journal of Business & Economic Statistics, v. 39, 2, pp. 575-588, **WP 1092 (January 2017)**.

2022

- ANDINI M., M. BOLDRINI, E. CIANI, G. DE BLASIO, A. D'IGNAZIO and A. PALADINI, *Machine learning in the service of policy targeting: the case of public credit guarantees*, Journal of Economic Behavior & Organization, v. 198, pp. 434-475, **WP 1206 (February 2019)**.
- ANGELICO C., J. MARCUCCI, M. MICCOLI and F. QUARTA, *Can we measure inflation expectations using twitter?*, Journal of Econometrics, v. 228, 2, pp. 259-277, **WP 1318 (February 2021)**.
- BARTOCCI A., A. NOTARPIETRO and M. PISANI, *Covid-19 shock and fiscal-monetary policy mix in a monetary union*, Economic challenges for Europe after the pandemic, Springer Proceedings in Business and Economics, Berlin-Heidelberg, Springer, **WP 1313 (December 2020)**.
- BOTTERO M., C. MINOIU, J. PEYDRÒ, A. POLO, A. PRESBITERO and E. SETTE, *Expansionary yet different: credit supply and real effects of negative interest rate policy*, Journal of Financial Economics, v. 146, 2, pp. 754-778, **WP 1269 (March 2020)**.
- BRONZINI R., A. D'IGNAZIO and D. REVELLI, *Financial structure and bank relationships of Italian multinational firms*, Journal of Multinational Financial Management, v. 66, Article 100762, **WP 1326 (March 2021)**.
- CANTELMO A., *Rare disasters, the natural interest rate and monetary policy*, Oxford Bulletin of Economics and Statistics, v. 84, 3, pp. 473-496, **WP 1309 (December 2020)**.
- CARRIERO A., F. CORSELLO and M. MARCELLINO, *The global component of inflation volatility*, Journal of Applied Econometrics, v. 37, 4, pp. 700-721, **WP 1170 (May 2018)**.
- CIAPANNA E. and G. ROVIGATTI, *The grocery trolley race in times of Covid-19. Evidence from Italy*, Italian Economic Journal / Rivista italiana degli economisti, v. 8, 2, pp. 471-498, **WP 1341 (June 2021)**.
- CONTI A. M., A. NOBILI and F. M. SIGNORETTI, *Bank capital requirement shocks: a narrative perspective*, European Economic Review, v. 151, Article 104254, **WP 1199 (November 2018)**.
- FAIELLA I. and A. MISTRETTA, *The net zero challenge for firms' competitiveness*, Environmental & Resource Economics, v. 83, pp. 85-113, **WP 1259 (February 2020)**.
- GUISO L., A. POZZI, A. TSOY, L. GAMBACORTA and P. E. MISTRULLI, *The cost of steering in financial markets: evidence from the mortgage market*, Journal of Financial Economics, v. 143, 3, pp. 1209-1226, **WP 1252 (December 2019)**.
- LAMORGESE A. and D. PELLEGRINO, *Loss aversion in housing appraisal: evidence from Italian homeowners*, Journal of Housing Economics, v. 56, Article 101826, **WP 1248 (November 2019)**.

"TEMI" LATER PUBLISHED ELSEWHERE

- LI F., T. MÄKINEN, A. MERCATANTI and A. SILVESTRINI, *Causal analysis of central bank holdings of corporate bonds under interference*, *Economic Modelling*, v.113, Article 105873, **WP 1300 (November 2020)**.
- LOBERTO M., A. LUCIANI and M. PANGALLO, *What do online listings tell us about the housing market?*, *International Journal of Central Banking*, v. 18, 4, pp. 325-377, **WP 1171 (April 2018)**.
- MIRENDA L., M. SAURO and L. RIZZICA, *The economic effects of mafia: firm level evidence*, *American Economic Review*, vol. 112, 8, pp. 2748-2773, **WP 1235 (October 2019)**.
- MOCETTI S., G. ROMA and E. RUBOLINO, *Knocking on parents' doors: regulation and intergenerational mobility*, *Journal of Human Resources*, v. 57, 2, pp. 525-554, **WP 1182 (July 2018)**.
- PERICOLI M. and M. TABOGA, *Nearly exact Bayesian estimation of non-linear no-arbitrage term-structure models*, *Journal of Financial Econometrics*, v. 20, 5, pp. 807-838, **WP 1189 (September 2018)**.
- ROSSI P. and D. SCALISE, *Financial development and growth in European regions*, *Journal of Regional Science*, v. 62, 2, pp. 389-411, **WP 1246 (November 2019)**.
- SCHIVARDI F., E. SETTE and G. TABELLINI, *Credit misallocation during the European financial crisis*, *Economic Journal*, v. 132, 641, pp. 391-423, **WP 1139 (September 2017)**.
- TABOGA M., *Cross-country differences in the size of venture capital financing rounds: a machine learning approach*, *Empirical Economics*, v. 62, 3, pp. 991-1012, **WP 1243 (November 2019)**.

FORTHCOMING

- APRIGLIANO V., S. EMILIOZZI, G. GUAITOLI, A. LUCIANI, J. MARCUCCI and L. MONTEFORTE, *The power of text-based indicators in forecasting Italian economic activity*, *International Journal of Forecasting*, **WP 1321 (March 2021)**.
- BARTOCCI A., A. NOTARPIETRO and M. PISANI, *Non-standard monetary policy measures in non-normal times*, *International Finance*, **WP 1251 (November 2019)**.
- CIAPANNA E., S. MOCETTI and A. NOTARPIETRO, *The macroeconomic effects of structural reforms: an empirical and model-based approach*, *Economic Policy*, **WP 1303 (November 2022)**.
- DI ADDARIO S., P. KLINE, R. SAGGIO and M. SØLVSTEN, *It ain't where you're from, it's where you're at: hiring origins, firm heterogeneity, and Wages*, *Journal of Econometrics*, **WP 1374 (June 2022)**.
- FERRARI A. and V. NISPI LANDI, *Whatever it takes to save the planet? Central banks and unconventional green policy*, *Macroeconomic Dynamics*, **WP 1320 (February 2021)**.
- FERRARI A. and V. NISPI LANDI, *Toward a green economy: the role of central bank's asset purchases*, *International Journal of Central Banking*, **WP 1358 (February 2022)**.
- LILLA F., *Volatility bursts: a discrete-time option model with multiple volatility components*, *Journal of Financial Econometrics*, **WP 1336 (June 2021)**.
- LOBERTO M., *Foreclosures and house prices*, *Italian Economic Journal / Rivista italiana degli economisti*, **WP 1325 (March 2021)**.
- LOMBARDI M. J., M. RIGGI and E. VIVIANO, *Bargaining power and the Phillips curve: a micro-macro analysis, and wages*, *Journal of the European Economic Association*, **WP 1302 (November 2020)**.
- RIZZICA L., G. ROMA and G. ROVIGATTI, *The effects of shop opening hours deregulation: evidence from Italy*, *The Journal of Law and Economics*, **WP 1281 (June 2020)**.
- TANZI G. M., *Scars of youth non-employment and labour market conditions*, *Italian Economic Journal / Rivista italiana degli economisti*, **WP 1312 (December 2020)**.