Price effect of mutual fund flows on the corporate bond market.

The French case

Virginie Coudert* and Dilyara Salakhova**

Abstract

We study how investors' withdrawals from mutual funds may affect the French corporate bond market. To do so, we use monthly data on flows to the French bond and mixed mutual funds as well as a database on their bond holdings from 2011 to 2017 provided by the Banque of France Statistics Department. After selecting a sample of French corporate bonds, we run panel data regressions at the bond-level to explain their yields with macroeconomic variables, such as the sovereign 10-y rate, the short-term rate, the Vstoxx as well as bond-specific variables, such as the residual maturity, liquidity and the issuer's probability of default. We also account for the corporate securities purchasing programme (CSPP) implemented by the ECB since June 2016 by adding dummy variables on the eligible bonds. Then we add variables related to inflows/outflows to test for several hypotheses. Our results show: that first, flows to funds affect the yields of all corporate bonds across the board. Second, this effect is asymmetric since outflows have a greater impact on yields than inflows. Third, the greater the funds' market share in a specific bond the higher the impact on this bond is. On the other hand, the effects of outflows on liquidity premia are not clear-cut; neither do we find any significant effect of the detention by funds on the response of bond yields to financial stress.

Keywords: mutual funds, bond holdings, bond yield, fund flows

JEL codes: G12, G23

(*) Financial Stability Directorate, Bank of France, virginie.coudert@banque-france.fr

(**) Financial Stability Directorate, Bank of France, dilyara.salakhova@banque-france.fr

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1. Introduction

Assets under management by investment funds have surged for the last decade in most countries. They amounted to €11 trillion in the euro area in 2017, which is about the size of the annual GDP. This tremendous development potentially related to the low interest rate environment raises many questions regarding financial stability. Fixed income mutual funds stand out in this debate for three reasons. First, they have attracted several times more inflows than all the other funds combined since the crisis (Feroli et al. (2014)). Second, they invest in rather illiquid assets such as corporate bonds. Third, unlike equity mutual funds, little research is available on bond funds due to the scarcity of the data. In this paper, we use detailed data on corporate bond holdings by French bond and mixed mutual funds and study how funds' flows affect bond yields.

A key vulnerability of bond funds involves possible liquidity mismatch between assets and liabilities in open-ended funds, i.e. the difference between the ease and speed with which investors may redeem their units and the ease and speed with which portfolio assets can be sold. This mismatch creates a risk of runs linked to the presence of a first-mover advantage in the redemption decision due to the fact that funds have to readjust their portfolio following outflows. When assets are less liquid, liquidation costs are higher therefore decreasing net asset value available for remaining investors. Indeed, Goldstein et al. (2017) and Feroli et al. (2014) show that investors' flows are particularly sensitive to bad performance of funds investing in less liquid assets such as corporate bonds unlike for equity funds (Ippolito (1992), Sirri & Tufano (1998) among others). Given the growing size of the asset management industry, the question about the effects of funds' inflows and outflows on asset price dynamics is especially acute. Several studies (e.g., Warther (1995), Edelen (1999)) find that aggregate mutual funds' flows affect contemporaneous stock returns. Coval and Stafford (2007) show that large inflows and outflows of funds are able to exert price pressures in such a liquid market as the U.S. equity market. Greenwood and Thesmar (2011) showed that US stocks largely held by mutual funds were more fragile due to the concentration in their ownership and hence more volatile than other assets. Such factors are likely to be even stronger in the corporate bond market given its low liquidity and low depth in comparison to equity markets. However, there are very few studies analysing corporate bond market since data are less accessible and more difficult to work with.

In this paper, we analyze the effects on the corporate bond market exerted by the French bond and mixed mutual funds (French bond funds to simplify, or FBF, from now on). Indeed, these funds domiciled in France have become a major player in the financial markets as their assets under management (AUM) reached € 638 bn in 2017. We use Bank of France data on funds' bond holdings that provides us with the amount held by the FBF in each bond on a monthly basis from July 2011 to December 2017. We also have monthly data on the total flows in and out of these funds during the period. Among all the bonds held by the FBFs, we retain those issued by French companies. Indeed, we concentrate on the French corporate bond market for two reasons: (i) the substantial home bias makes French issuers predominant in the FBFs' portfolio (ii) the lower liquidity of the corporate bond market compared to that of sovereigns or financials. These two reasons make the French corporate market the most likely to be affected by FBFs flows.

Given our bond-level dataset, we seek to identify the effect of aggregate fund flows on individual bond yields while controlling for bond characteristics. More specifically, we state five hypotheses about the responses of bond yields to net flows of funds at a bond-level. First, we verify that flows in and out of mutual funds affect corporate bond yields. This question has been extensively studied for equity markets, and numerous studies document a positive relationship between aggregate fund flows and contemporaneous equity market returns (e.g., Warther (1995), Edelen (1999) and Edelen and Warner (2001) for the U.S. equity market; Ben-Raphael et al. (2011) for the equity market in Israel). Second, we test for a concave relationship between fund flows and bond prices that may stem from the low liquid nature of corporate bonds. Namely we want to determine if outflows affect bond yields to a greater extent than inflows. Asymmetric effects are found by the IMF (2015) but depend on the analyzed market: outflows have a greater effect for equity and bond funds invested in emerging markets and U.S. municipal bonds; no or limited effect for U.S. equity and high-yield bonds. Third, we test if the impact on yields due to the funds' flows is stronger for the bonds that funds hold a larger share of. The results confirm these three hypotheses. First, net fund flows do have an effect on bond yields. Second the effect is stronger for those bonds that are held by funds to a larger extent. Third, the magnitude of the yield change is significantly higher in case of outflows than inflows.

We also test for two additional hypotheses. First, we investigate if the liquidity premium is affected by redemptions. This may happen if funds sell more liquid assets when face investors' redemptions as suggested by Manconi et al. (2012) and Chernenko and Sunderam (2016). However, our results are mixed in this respect and sensitive to the econometric specification. This lack of a significant effect may be related to Baranova et al. (2018) who suggest that majority of surveyed asset managers rather use a pro-rata principal of asset sales in order to address liquidity outflows. Second, we want to know if the bonds the most held by the funds are more or less sensitive to financial stress by introducing interactive variables reflecting financial stress in the regression. IMF (2015) suggests an amplification effect that may be due to funds' need to sell these bonds during turbulent times. Our findings on the adverse effect of greater ownership concentration on the bond yields are significant but sensitive to econometric specifications.

Our paper contributes to the literature in three main ways. First, we focus on the impact of mutual bond fund flows on the corporate bond market. As mentioned earlier, the bulk of literature concerns the effects of mutual fund flows on equity returns. Warther (1995), Edelen (1999), Edelen and Warner (2001), Ben-Raphael et al. (2011) show that aggregate mutual fund flows affect contemporaneous stock returns using aggregate data. Goldstein et al. (2016) study corporate bond funds but from a different perspective. They analyze how flows in/out of bond funds are associated with funds' performance. Their finding indicates a source of potential fragility for bond funds, namely corporate bond funds' outflows are more sensitive to bad performance than equity funds' outflows, especially funds with less liquid assets.

Second, we use bond-level data instead of aggregate bond market data to analyze the price pressure effects. This allows us to control for other factors determining bond yields, thus providing a more robust estimation of the effect of fund flows on bond prices. Few studies use security-level data. Coval and Stafford (2007) employ security-by-security holdings at a fund-level and show that sudden increases/decreases in net flows to funds exert significant price pressure in U.S. equity markets. Manconi et al. (2012) focus on bond-level holdings of mutual funds. They study how institutional investors contributed to the propagation of the crisis from securitized to corporate bonds. Namely, bond-holders more exposed to problematic securitized bonds had to sell more liquid corporate bonds to a larger extent therefore increasing the spreads of the corporate bonds they retained. Indeed, the bonds which were the most held by funds exposed to the "toxic securities" before the crisis were the most hit by the crisis. As well, the funds facing the more severe redemptions and high volatility in their inflows also tended to sell higher share of their corporate bond holdings than other funds.

Another contribution is to study a market different from the U.S. Almost all the above-mentioned papers deal with the U.S. markets due to an easy access to data and good data quality. However, U.S. markets are special in the sense that they are largely open to many international investors. A smaller national market, like the French one, is interesting to study because domestic funds may hold a larger part of the locally issued bonds due to a persisting home bias. Moreover, French investment funds have become non negligible in the euro area financial landscape, as they now rank fourth behind Luxembourg, Germany and Ireland, holding 10% of the all euro area funds' assets (Ponsart and Salvio, 2018). To our best knowledge, only Bellando and Tran-Dieu (2011) and Jondeau and Rockinger (2004) study flows in French mutual funds, although their focus is on the flow-performance relationship in French equity funds. Bellando and Tran-Dieu (2011) find a convex relation between current net flows and past relative performance. More specifically, good past performance attracts more investors but bad past performance does not lead to significant fund outflows. As the authors underline this relationship is the same as in the American case but the effect is quantitatively smaller.

The remaining paper is structured in the following way. Section 2 describes the data and gives some key statistics about the bonds held by the FBF. In Section 3, we discuss the hypotheses of the impact of funds' holdings on the corporate bond market and the methods to test them econometrically. Section 4 presents the econometric results. Section 5 provides robustness checks. Section 6 concludes.

2. Data and Stylized Facts

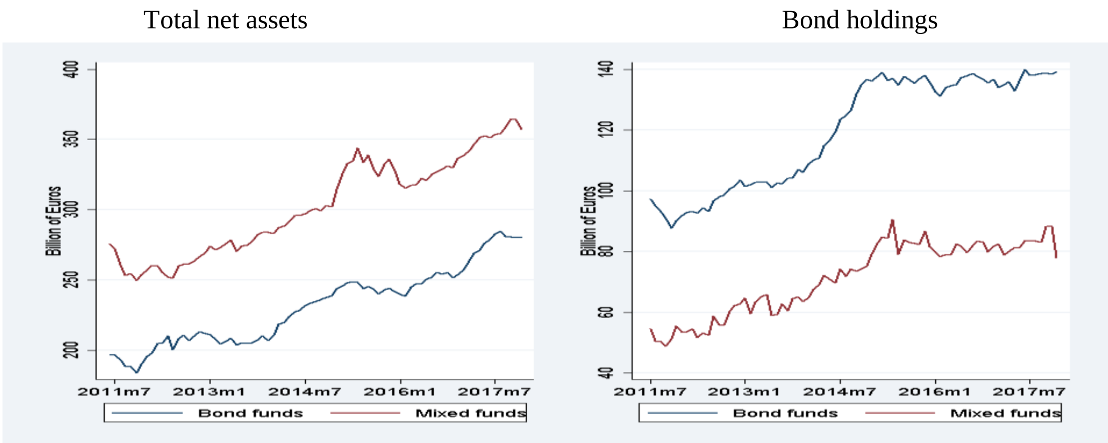
We rely on a database provided by the Bank of France Statistics Department that reports all the bond holdings by all the mutual funds domiciled in France. The frequency is monthly, and the time period spans from July 2011 to December 2017. This database is detailed at the bond-level but not at the fund level, as it only supplies the total holdings of all funds for each bond.

2.1 An overview of the whole FBFs' bond portfolio

The database includes the bond holdings of two types of investment funds: (i) the bond funds that by definition invest mainly in bonds and (ii) the mixed funds that invest in a mix of bonds and stocks. The evolution of their net assets and their bond holdings are depicted in Figure 1. Bond funds have less assets under management than mixed funds (€281bn vs. €357 bn in December 2017), but own nearly twice more bonds (€139 bn vs. €78 bn).

As we do not try to distinguish the two types of funds in this paper, we aggregate all the holdings by the two categories of funds, and refer to them as the French bond funds (FBF) in the following. Taken together, the FBFs' net assets amounted to €638 bn at the end of 2017 including €217 bn invested in bonds. This is approximately half of the assets of all investment funds in France (Ponsart and Salvio, 2018).

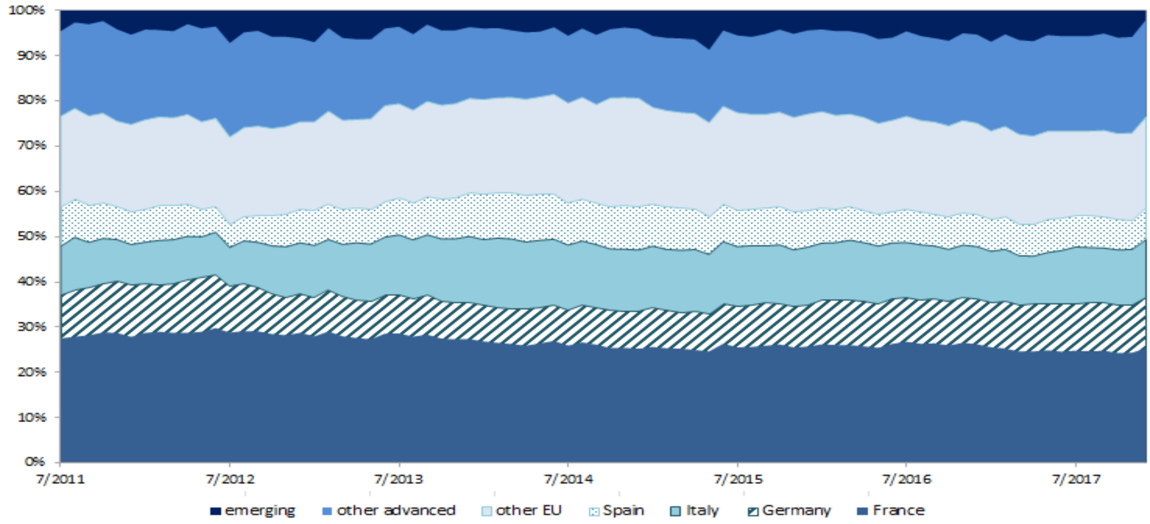
Figure 1. Total net assets and total bond holdings of the bond and mixed funds, in billions euros



Source: Webstat, Banque de France

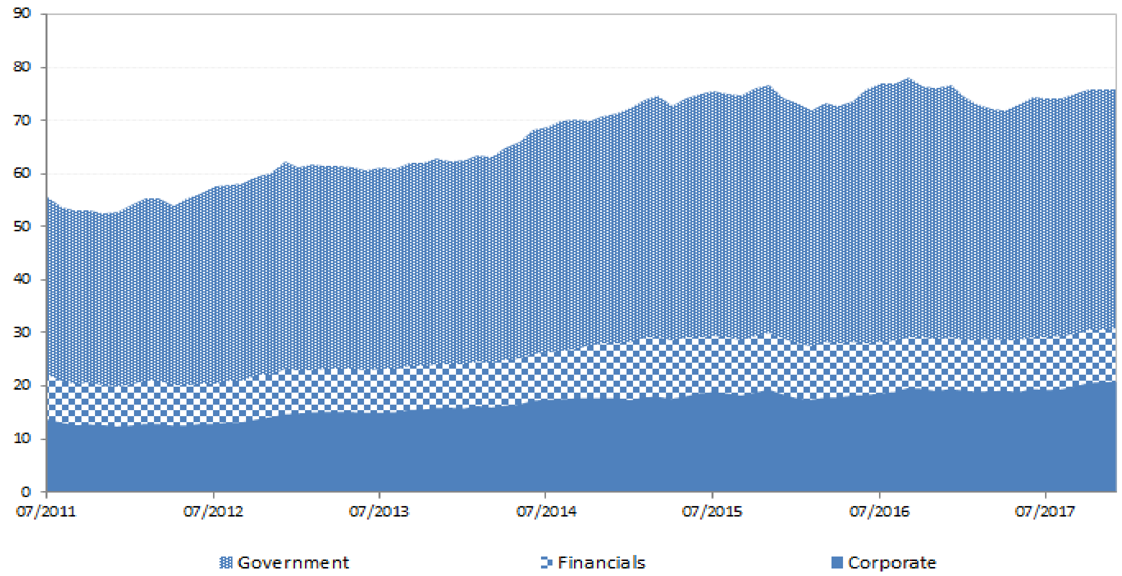
France is the main investment destination, attracting 27% of the total assets on average over the period. Not surprisingly, the share of the French securities in the FBF's portfolio reached its highest share, 30% at the peak of the euro area crisis in June 2012 (Figure 2). The home bias then receded gradually with the share of French bonds decreasing to 25% in December 2017. Among the euro area countries, Italy, Germany and Spain are the preferred investment destinations, making up to 30% of the portfolio. On the whole, 76% of the bonds held by the FBF are issued by European Union entities. The share of emerging countries is limited to 5% of the total.

Figure 2. Bond holdings of the FBF (mixed and bond funds combined) by issuer country, in %



Corporate bonds amount to 38% of the FBF's home portfolio, or €21 bn in December 2017 (Figure 3). This category is just behind the French sovereign bonds that account for about half of the home portfolio. The rest of the bond holdings are issued by financial institutions. If a market may be affected by the FBF's behavior, the French corporate bond market is the most likely candidate for two reasons: (i) the FBF hold a substantial share of this market (see next section); (ii) the French corporate bond market is rather narrow and little liquid.

Figure 3. French bonds held by the FBF by sector, in billions of euros.



2.2 Selection of the sample of corporate bonds and bond-specific variables

The sample consists of 461 corporate bonds issued in EUR by about 200 French firms and held by the FBF from July 2011 to December 2017. Note that the number of bonds available at each period varies through time because not all bonds are alive simultaneously as some are not yet issued while others have already matured. These bonds are selected on the ground that (i) their yields are available on Bloomberg over the period and they are either (ii) reimbursed at maturity, or (iii) callable, meaning that the issuer has an option to reimburse it before maturity at predetermined periods of time, or (iv) perpetual, meaning that bonds have no fixed maturity and can be reimbursed any time at the issuer's choice. We exclude convertible bonds because their price is strongly driven by the evolution of the stock market and another econometric specification would be necessary to explain their yields.

The dataset includes two broad categories of data: specific to each bond and macro data. We summarize all the data below. At the bond-level, for each bond *i* identified by its ISIN, we consider the following variables:

(i) outstanding amounts of bonds held by the FBF (sum of bond *i* at time *t* held by both bond and mixed mutual funds), denoted $H_{i,t}$, that are provided by the Bank of France Statistics Department;

(ii) yield to maturity $y_{i,t}$, market $P_{i,t}$, bid $P_{i,t}^{b}$ and ask $P_{i,t}^{a}$ prices, all extracted from Bloomberg; we then calculate the bid-ask spread as $Liq_{i,t}$ = 100*($P_{i,t}^{b}$/ $P_{i,t}^{a}$-*1*) used as a proxy for (il)liquidity;

(iii) main bond characteristics: issued volume ($Vol_{i,}$), issue and redemption dates, issue price P_i^0, coupon and bond type (either at maturity, callable, or perpetual) obtained from Bloomberg. We also extract the 5-year probability of default calculated by Bloomberg. From the redemption date, we calculate the residual maturity by counting number of months left before redemption. In order to avoid dropping perpetual bonds from the regression, we set their maturity arbitrarily at 50 years.

(iv) We compute the share $w_{i,t}$ owned by the FBFs in the market of each bond *i*. To do so, we divide the holdings $H_{i,t}$ by the outstanding amount of each bond. The latter is equal to the amount issued Vol_i multiplied by the current market price $P_{i,t}$, relative to the issue price P_i^0:

$$w_{i,t} = \frac{H_{i,t}}{VOLi \;\; P_{i,t}/P_i^0} , 0 < w_{i,t} < 1 \qquad (1)$$

At the macro-level, we add macroeconomic variables common to all bonds such as interest rates: the 10-year sovereign bond rate, the 3-month Euribor interest rate, the volatility of stock price indexes, the VIX for the US (S&P500) and the Vstoxx for the European Union (Eurostoxx 50), that are extracted from Bloomberg.

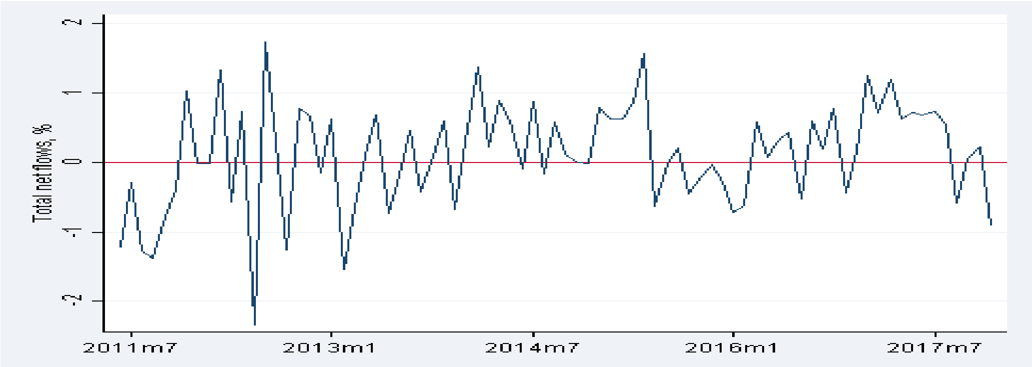
Relative net inflows into the FBFs

We extract the net flows entering into the funds F_t (either positive or negative) and the total funds' net assets under management A_t from Webstat, Banque de France online database. We then take these flows as a percentage of the total net assets A_{t-1} held by the FBF at the previous period. This relative flows ratio denoted ϕ_t is our variable of interest in the econometrics section.

$$\phi_t = 100 * \frac{F_t}{A_{t-1}} \qquad (2)$$

A striking feature of these flows is their great volatility, as they oscillate between positive and negative values all over the sample (Figure 4). As they are negative nearly 40% of the time, the potential adverse effects of withdrawals are a real issue to study.

Figure 4. Relative flows into the FBF (net flows divided by assets under management), negative values correspond to redemptions, in %.



Source: Webstat, Banque de France

2.3 Main characteristics of the corporate bonds held by the FBF

We now take a look at the main characteristics of bonds in our final sample (Table 1). Several features stand out. First, bond maturity type evolved over the period: the share of bonds paid off at maturity notably declined to 42% in 2017, whereas they were predominant in 2011 (86%). Meanwhile, the callable bonds gained in importance, as they now reach 48% of the FBF's portfolio against 10% in 2011. In the context of declining interest rates, many firms prefer to issue callable bonds, that they can reimburse in case the interest rates continue to fall; some companies may also expect an improvement in their rating in the future relatively to that obtained during the financial crisis; in both cases, firms are ready to pay a premium to issue callable bonds that will allow them to issue new debt with lower interest rates at the moment of their choice.

Second, most bonds held by funds have a high pay-off priority: 81% are either senior or first lien in 2017 and only 13% are junior subordinated. This structure is quite stable over the period. Third, risk-taking seems to be contained when considering the 5-year probabilities of default (PD). As expected, the PDs peaked at the height of the euro crisis in 2012, and then receded in the following years. The median is 1.0% only in 2017, and 95% of bonds have a PD smaller than 4% at that time. These PDs are calculated by Bloomberg from a structural model involving different factors such as equity prices, amount of debt, etc. If we neglect the possible biases in calculating these PDs, the 1.0% median 5y-PD of the bonds in the FBFs' portfolio approximatively matches the 0.9% historical default rate of all investment grade corporates at this 5-y horizon, when calculated at the global level for the 1981-2017period by Standard& Poor's (2018).

Fourth, the FBFs' share of each bond market increased over the period, which is in line with the development in the total fund holdings. The median share augmented from 6.7% up to 8.3%. However, it varies significantly across the bonds: 5% of bonds have more than 33.5% of their outstanding value detained by the FBFs, and 5% of them, less than 0.6%. Fifth, the yields to maturity declined over the period, as most interest rates did under the effect of the ECB's asset purchase programme. Yields are quite spread: 5% of them are below -0.1% while 5% exceed 5.7%, in 2017. Lastly, the coupons slightly declined over the period, but this movement is much less pronounced than that of the yields: (i) contrary to the yields, the coupons are fixed over the life of the bond; hence as long as the bonds are not reimbursed, their coupons stay the same; as the bonds are long-term, the sample of bonds only slowly changes from one year to another, which explains the sluggish movements in the coupons; (ii) there were more and more callable bonds over the period, and those bonds must offer better coupons in order to compensate for their possible early pay-off at the decision of the issuer.

Table 1. Characteristics of the corporate bonds held by the FBF in the sample (*)

Year	(1) Maturity type, in %			(2) Payment rank, in %			(3) Probability of default, in %		
	At maturity	Callable	Perpetual	1st lien	senior	sub	p5	p50	p95
2011	85.97	9.75	4.18	5.58	79.10	14.62	0.53	2.29	7.69
2012	85.71	9.90	3.77	5.34	80.31	13.20	0.64	2.87	8.82
2013	80.38	14.06	5.05	6.03	78.02	13.13	0.40	1.49	5.58
2014	70.36	22.04	6.91	9.51	72.25	13.45	0.30	1.28	4.78
2015	60.05	30.84	8.39	10.98	69.40	14.09	0.38	1.42	5.58
2016	52.15	38.67	8.55	10.80	70.06	13.58	0.55	1.80	7.30
2017	42.78	47.75	9.13	12.24	68.61	13.45	0.27	1.00	3.96

Year	(4) Bond share held by FBF in %			(5) Yield to maturity, in %			(6) Coupon, in %		
	p5	p50	p95	p5	p50	p95	p5	p50	p95
2011	0.69	6.72	26.10	1.86	4.10	9.99	3.18	4.88	8.50
2012	0.72	6.74	24.24	0.84	2.91	11.08	3.00	4.82	8.50
2013	0.67	7.64	25.03	0.61	2.39	7.90	2.63	4.75	8.50
2014	0.64	8.42	31.83	0.41	1.87	7.07	2.50	4.63	8.50
2015	0.71	8.56	35.78	0.21	1.62	7.15	1.88	4.50	8.50
2016	0.73	8.37	35.32	-0.07	1.29	7.81	1.75	4.25	8.50
2017	0.59	8.30	33.47	-0.08	1.24	5.72	1.13	4.00	7.88

(*) Note: The sample consists of 461 corporate bonds issued in EUR by about 200 French firms and held by the FBF from July 2011 to December 2017. These bonds are selected on the ground that (i) their yields are available in Bloomberg over the period and (ii) they are either reimbursed at maturity, callable or perpetual.

The effect of the CSPP on bond yields

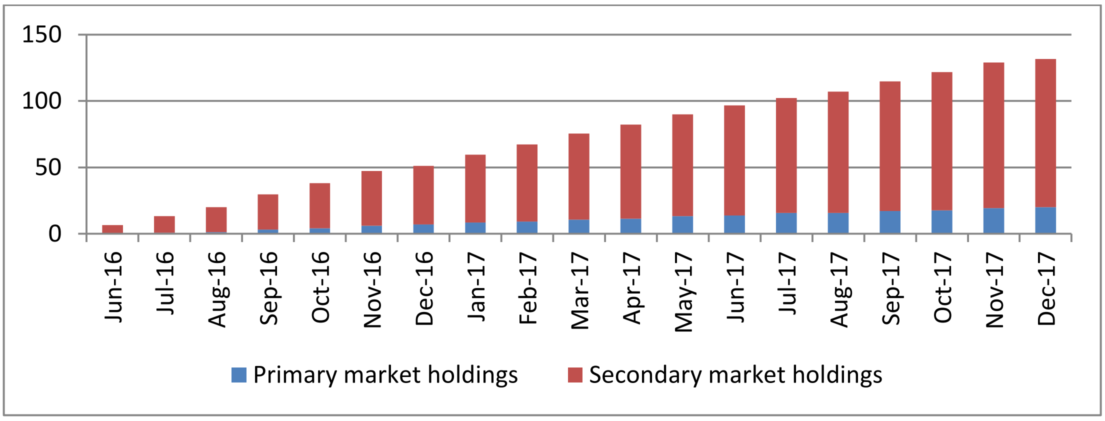
The European Central Bank (ECB) announced its "corporate securities purchase programme" (CSPP) in March 2016 and started regularly purchasing corporate bonds in June 2016. This measure is included in the asset purchase programme (APP) that aimed at reducing interest rates in the euro area and follows the public securities purchase programme (PSPP) that focused on the sovereign bonds. €130 bn of European corporate bonds were progressively bought under the CSPP by December 2017, as shown in Figure 5. Most of the purchases are made on the secondary market. The ECB publishes the information on country breakdown of purchases on a semi-annual basis starting from Q3 2017. The bonds issued by French firms make up to about 30% of the purchased amount in Q3 2017 and 29% in Q1 2018.

The CSPP targets bonds issued by the non-financial firms domiciled in the euro area that meet the following eligibility conditions: they must be (i) investment-grade; (ii) issued in euros; (iii) residual maturity ranging between 6 months and 31 years; (iv) yields higher than the ECB deposit facility rate. These conditions exclude the perpetual, but not the callable bonds. The set of "CSPP-eligible bonds" defined by the above conditions is a subset of those accepted as collateral in the ECB monetary policy operations, named the ECB-eligible bonds.

In our sample, there are 102 ECB-eligible bonds identified using the list of the ECB-eligible securities available on the ECB's site. Four of them do not meet the conditions of maturity or have their yields-to-maturity below the deposit facility rate. Hence, we end up with 98 CSPP-eligible ISIN. From this set, 67 bonds had been actually purchased by the Eurosystem in December 2017, (versus 61 in June 2017), as we can see from the list of securities held by the ECB for the period beginning in June 2017 on the ECB website.[1] Among the 6 new bonds purchased between June and December 2017 , 4 were issued after June 2017, so probably bought on the primary market.

The purchased bonds are not different from the eligible ones that have not been purchased when we compare their yield or the issuer's probability of default. The only difference lies in their issue date (and hence in the residual maturity) : the purchased bonds are generally more recently issued (by three years on average, though with a large variance). More recent bonds are indeed more likely to be present on the secondary market than older ones. However, as all CSPP-eligible bonds are susceptible be purchased at any time by the Eurosystem, we do not differentiate them from the subset of bonds that have been actually bought. Therefore in our econometric estimations, we will consider the whole set of the CSPP-eligible bonds, and not those actually purchased.

Figure 5. ECB holdings of corporate securities under the CSPP, in billion euros



Source: ECB website.

As the goal of the programme is to facilitate credit conditions for firms, it should have an impact on bond yields. De Santi et al. (2018) find several beneficial effects such as a decrease in the corporate bond spreads, a development in the issuances and the lengthening of maturities using a euro area sample. They also showed that the effect of the CSPP on spreads was mostly concentrated over the two weeks following the announcement in March 2016. The decline in spreads concerned all bonds, whether eligible or not, though the move was stronger on eligible ones. Abidi and Miquel-Flores (2018) reach the same conclusion by an econometric analysis focusing on the bonds near the BBB-rating, which is the lower limit for investment-grade bonds.

3. Hypotheses and methodology

We rely on regressions at the bond level to measure the impact of the flows entering the funds on the corporate bond market.

3.1 Preliminary steps: defining the control variables

In order to capture the impact of the FBF on the bond market, a preliminary step is to run a regression explaining the corporate bond yields by their usual factors. We retain five broad categories of explanatory variables to account for the formation of corporate bond yields: (i) the risk-free rate and

[1] The CSPP started in June 2016, but the ECB started publishing its holdings on a weekly basis only in June 2017. A number of checks of holdings in June, September and December 2017 suggests that most securities are consistently held from one period to the other.

time to maturity; (ii) credit risk; (iii) risk aversion; (iv) liquidity premium; (v) the intrinsic characteristics of bonds, such as covenants, maturity-type or pay-off seniority.

Let us briefly review these determinants and their expected signs for a bond yield $y_{i,t}$ where the subscript *i* stands for bond *i* and *t* is the current time.

First, risk-free rates are key factors in bond pricing. Strictly speaking, the bond yield should be related to the risk free rate $r_{\tau,t}$ of the exact same maturity in order to avoid any distortion due to the term structure. As maturity varies across the bonds in the sample and obviously across time, we cannot put in the regression the risk-free rate of the exact same maturity, we then retain two risk-free interest rates of long and short maturity as explanatory variables: the French 10-year sovereign bond rate and the 3-month EURIBOR. We also include residual maturity τ in the regression since bonds with longer maturity are expected to offer higher yields.

Second, bond spreads depend mainly on credit risk which in turn is determined by the borrower's probability of default, its expected recovery rate, time to maturity and risk-free rates. Here, we use the issuer's probability of default calculated by Bloomberg as a proxy for credit risk.

Third, even if probabilities of default and recovery rates are constant, the risk premium may increase due to a rise in risk aversion. This is seen, for example, in times of financial stress when all bond spreads tend to rise for any given rating. These times of financial stress can be identified by the increase in the implied volatility in the global stock markets, represented by the Vstoxx or the VIX. A number of studies have adopted the VIX as a measure of "financial stress" and risk aversion (see for example, Coudert et al., 2013; Rey, 2016).

Fourth, bond yields also incorporate a non–default component related to the market liquidity (Longstaff et al. 2004; Han and Zhou, 2011; Bao et al., 2011). We will use the bid-ask spread as a measure of the market illiquidity. All the four above factors have positive expected signs: risk-free interest rates, residual maturity, probability of default, equity market volatility and illiquidity are supposed to mitigate bond prices and therefore raise their yield to maturity.

Next, we take into account the intrinsic features of bonds by adding the coupon to the explanatory variables, as well as dummies standing for the maturity type and the payment rank. The maturity type distinguishes the bonds paid at maturity, perpetual or callable. We expect the perpetual and callable bonds to have higher yields than the standard ones; pay-off priority can also play a role. As these intrinsic features are fixed over the whole life of the bond, they cannot enter a fixed effect regression.

Lastly, we account for the effects of the CSPP on bond yields. We therefore consider the dummy variable $CSPP_{it}$ that is equal to 1 for the 98 CSPP-eligible bonds in the sample at the time of the CSPP announcement in March 2016. We also add a time indicator function $CSPP\_All_t$ set to 1 at the time of the CSPP announcement in March 2016 and zero elsewhere. This variable is meant to capture the effects on all bonds across the board of the CSPP announcement.

We gather all the above explanatory variables in a regression explaining the bond yields.

$$y_{i,t} = \sum_{j=1}^{J} \gamma_j C_{j,i,t} + \mathrm{c} + \varepsilon_{i,t} \tag{3}$$

where $y_{i,t}$ is bond *i* 's yield–to-maturity at the end of month *t*, $C_{j,i,t}$ denotes the *j*th variable among all those mentioned above, *c* is an intercept and $\varepsilon_{i,t}$ the residual of the equation. γ_j are coefficients to estimate, common to all bonds, and reflecting the sensitivity of the bond yield to the different variables. Starting from this benchmark regression, we introduce the explanatory variables one after the other in order to test the hypotheses.

3.2 Hypothesis 1: Shocks on net flows into the FBF affect corporate bond yields

This hypothesis allow us to determine if money entering (or exiting) the funds exerts an impact on the bond yield. Indeed, large inflows in the FBF may provoke a surge in demand for corporate bonds and may release a positive signal concerning the market evolution. As bond supply does not adjust simultaneously, this creates an upward price pressure, mitigating their yield. Conversely, investors' redemptions from funds would have the opposite effect.

To test this hypothesis, we add the relative net flows entering into the FBF to the benchmark regression once the relevant control variables have been selected.

$$y_{i,t} = \sum_{j=1}^{J} \gamma_j C_{j,i,t} + \alpha\, \phi_t + c_i + \varepsilon_{i,t} \qquad \text{(Model 1)}$$

where ϕ_t is the flows in the FBF as a percentage of the total amount held by the industry at the previous period, as stated above (Section 2.3). The estimated α coefficient in regression (R1) allows us to test for the impact of the funds' flows by using a standard Student test. The null hypothesis ($H0_1$) is that the flows entering the funds have no impact on the corporate bond market. The alternative ($H1_1$) is that inflows do have an impact.

($H0_1$) "The flows in the FBF have no impact on the bond yields" $\Leftrightarrow \hat{\alpha} = 0$

($H1_1$) "The flows in the FBF have an impact on the bond yields" $\Leftrightarrow \hat{\alpha} < 0$

If we reject the null at the usual confidence interval of 95%, then we will consider that flows have an impact on bond yields. In this latter case, we will also check that the impact on yields is negative ($\hat{\alpha} < 0$) as expected. This means that more inflows exert an upward pressure on bond prices, which decreases their yields. In the estimations, we will also test for non linear effects of net flows on yields.

3.3 Hypothesis 2: Redemptions affect bond yields to a larger extent than inflows

We then test for a possible asymmetric effect. The question is to determine if investors' withdrawals from FBF have more adverse effects in increasing bond yields than inflows have favorable ones. We hence introduce the negative part ϕ_t^- of the relative flows into the regression, calculated as $\phi_t^- = \phi_t$ if $\phi_t < 0; = 0$ elsewhere.

$$y_{i,t} == \sum_{j=1}^{J} \gamma_j C_{j,i,t} + \alpha\, \phi_t + \alpha^-\, \phi_t^- + c_i + \varepsilon_{i,t} \qquad \text{(Model 2)}$$

The null hypothesis ($H0_2$) is that positive or negative inflows have the same impact on the bond yield. The alternative is that redemptions bring about a response of different magnitude, either larger or smaller.

($H0_2$) "The impact of FBF flows on yield is of the same magnitude, be they positive or negative" $\Leftrightarrow \widehat{\alpha^-} = 0$.

($H1_2$) "The impact of net FBF flows is of different magnitude for outflows than for inflows"

$\Leftrightarrow \widehat{\alpha^-} \neq 0$.

If the null is rejected, we will check the sign of the $\widehat{\alpha^-}$ coefficient. A negative sign indicates a larger response of bond yields to withdrawals than to positive inflows.

3.4 Hypothesis 3: The more a bond is detained by funds, the higher the impact of the funds' flows on its yield

The next step is to capture the effect of flows with respect to the funds' market share in a particular bond; more specifically, we want to know if this impact is stronger on the bonds that are detained in larger amounts by the FBF. In other words, we have to verify if the larger the share of the FBF in the bond market, the higher the impact of inflows or withdrawals.

To test this, we add an interactive term into the regression, denoted $\phi_t w_{i,t-1}$ that is equal to the relative flows in the FBF ϕ_t multiplied by the share $w_{i,t-1}$ of the FBFs' holdings in the total amount of bond *i* at the previous period. The share $w_{i,t-1}$, defined in Equation (1), is added into the regression as a control variable in order to properly test the interactive effect. It is taken with a lag in order to avoid any endogeneity issue. The equation to test is therefore the following:

$$y_{i,t} = \sum_{j=1}^{J} \gamma_j C_{j,i,t} + \mu\, w_{i,t-1} + \alpha\, \phi_t + + \alpha^- \phi_t^- + \beta\, \phi_t w_{i,t-1} + c_i + \varepsilon_{i,t} \qquad \text{(Model 3)}$$

The question here is to know if the yield of bond *i* is more affected by the flows in funds when the FBF already detain a larger share of the bond. The significance and sign of the $\hat{\beta}$ coefficient in Model 3 allows us to answer this question. The null hypothesis ($H0_3$) is that of no different impact.

($H0_3$) "The impact of inflows in the FBF on yields is the same across all bonds, whatever the holdings of the FBF in the bonds" ⇔ $\hat{\beta} = 0$

($H1_3$) "The more a bond is detained by funds, the higher the impact of the flows to funds on its yield" ⇔ $\hat{\beta} < 0$.

If we reject $H0_3$, we expect to have a negative sign on the $\hat{\beta}$ coefficient, meaning that the presence of the FBF on the market amplifies the response to inflows or outflows.

As there could also be an asymmetric effect of the interactive variable, we complete Model (3) by introducing the negative part of the interactive variable. This lets the possibility that redemptions have a stronger impact on yields of the bonds largely held by the FBFs than the inflows.

$$y_{i,t} = \sum_{j=1}^{J} \gamma_j C_{j,i,t} + \mu\, w_{i,t-1} + \alpha\, \phi_t + \alpha^- \phi_t^- + \beta\, \phi_t w_{i,t-1} + \beta^- \phi_t^- w_{i,t-1} + c_i + \varepsilon_{i,t} \qquad \text{(Model 3')}$$

($H0'_3$) "The impact of inflows in the FBF on yields is the same across all bonds, whatever the holdings of the FBF in the bonds" ⇔ $\hat{\beta} = 0 \cap \hat{\beta}^- = 0$

($H1'_3$) "The more a bond is detained by funds, the higher the impact of the flows to funds on its yield" ⇔ $\hat{\beta} = 0 \cup \hat{\beta}^- = 0$.

We conclude to an asymmetric effect if $\hat{\beta}^-$<0. In this case, redemptions have a stronger impact on yields of the bonds largely held by the FBFs than the inflows.

$$y_{i,t} = \sum_{j=1}^{J} \gamma_j C_{j,i,t} + \mu\, w_{i,t-1} + \alpha\, \phi_t + \alpha^- \phi_t^- + \beta\, \phi_t w_{i,t-1} + c_i + \varepsilon_{i,t} \qquad \text{(Model 3')}$$

3.5 Hypothesis 4: Fund redemptions tend to raise liquidity premia

Withdrawals from funds may also bring about changes in the liquidity premia according to the types of assets that funds sell first. Here, we want to know if the yields are differently affected by withdrawals according to bond (il)liquidity. On the one hand, if funds sell more liquid assets when experiencing investors' outflows, the yields of liquid bonds could be more affected than the others. On the other hand, they could also want to get rid of illiquid assets or to buy less of them in times of redemptions. Another possibility is that they sell all bonds pro-rata without discriminating them by liquidity. To answer this question, we add an interactive variable $Liq_{i,t}\, \phi_t^-$ equal to the liquidity proxy $Liq_{i,t}$ multiplied by the negative part of the funds flows ϕ_t^- in the regression.

This interactive variable is added on the top of the liquidity proxy that is already included in the control variables. The control liquidity variable then captures the standard effect of liquidity, that more illiquid bonds have lower price and hence higher yields. By adding this interactive variable, we stipulate that two different effects of liquidity are at play in times of withdrawals: the standard effect and the interactive effect resulting from the funds' behavior.

$$y_{i,t} = \sum_{j=1}^{J} \gamma_j C_{j,i,t} + \mu\, w_{i,t-1} + \alpha\, \phi_t + \alpha^-\, \phi_t^- + \beta\, \phi_t w_{i,t-1} + \beta^-\, \phi_t^- w_{i,t-1} + \lambda\, Liq_{i,t} \phi_t^- + c_i + \varepsilon_{i,t} \quad \text{(Model 4)}$$

The null hypothesis is the nullity of the Υ coefficient on the interactive term between liquidity and flows.

(H0$_4$) "The bond yield response to liquidity does not vary in case of outflows" ⇔ $\widehat{\lambda} = 0$

If the null hypothesis is rejected, we conclude that redemptions result in distortions in the liquidity premia. The sign of the λ coefficient will give us the sense of this effect, either to increase liquidity premia or to mitigate it. As negative flows ϕ_t^- are negative and *Liq* measures illiquidity, a positive sign of λ would mean that outflows reduce yields of illiquid securities. On the contrary, a negative sign means that the risk premia on illiquid bonds are amplified by redemptions.

3.6 Hypothesis 5: greater ownership concentration adversely affects bond yields in periods of stress

We also check the effect of financial stress on the funds' behavior and the bond market. More precisely, we want to know if a bond largely detained by funds is more fragile in periods of stress. To tackle this issue, we introduce an interactive term denoted $\sigma_t w_{i,t-1}$ in the former regression equal to the volatility of stock markets σ_t multiplied by the share of bonds *i* owned by funds at the previous period: $w_{i,t-1}$. The volatility in the global stock market is measured either by the Vstoxx or the VIX.

$$y_{i,t} = \sum_{j=1}^{J} \gamma_j C_{j,i,t} + \mu\, w_{i,t-1} + \alpha\, \phi_t + \alpha^-\, \phi_t^- + \beta\, \phi_t w_{i,t-1} + \beta^- \phi_t^- w_{i,t-1} + \lambda\, Liq_{i,t} \phi_t^- + \omega\, \sigma_t w_{i,t-1} + c_i + \varepsilon_{i,t} \quad \text{(Model 5)}$$

(H0$_5$) "The bond yield response to financial stress is the same for all bonds, whatever the FBFs' position on the bond market" ⇔ $\widehat{\omega} = 0$

(H1$_5$) "The bond yield response to financial stress depends on the share of bonds owned by the FBF" ⇔ $\widehat{\omega} \neq 0$

The alternative hypothesis $\widehat{\theta} \neq 0$ that holdings by funds make the market more sensitive to financial stress if $\widehat{\omega} < 0$ or more resilient if: $\widehat{\omega} > 0$.

4. Estimation results

The regressions are run over the period July 2011 to December 2017. The panel is unbalanced because at a given period of time, some of the bonds are not yet issued and others are already payed-off. The regressions are performed on 393 individual bonds, instead of 461 in the initial sample, because the issuer's probability of default is not available for a number of securities.

4.1 Benchmark regression with control variables

We begin by running the regressions that only include the control variables. Some of them are common to all bonds across the board, such as risk-free interest rates and volatility on the global equity market; others are bond-specific, like residual maturity, issuer's probability of default, market illiquidity and intrinsic features. We gather these two groups of variables in the regression together with the CSPP variables. The benchmark model can therefore be written as:

$$y_{it} = \sum_{m=1}^{M} \zeta_j X_{m,t} + \sum_{k=1}^{K} \rho_k B_{k,it} + \sum_{h=0}^{H} \tau_h CSPP_{i,t-h} + \sum_{h=0}^{H} \theta_h CSPP_{ALL_{t-h}} + c_i + \varepsilon_{i,t}$$
(Benchmark Model)

where $X_{m,t}$ denotes the set of *M* control variables common to all bonds, such as the sovereign bond rate, the short-term interest rate, the volatility in stock markets on average in month t; $B_{k,it}$ stands for the group of *K* variables specific to bond *i* such as residual maturity, probability of default, liquidity and constant intrinsic factors; $\zeta_{j,}$ ρ_k are coefficients to estimate, common to all bonds, and reflecting the sensitivity of the bond yield to the different variables.

As a preliminary step, we perform a number of tests to determine the best specification. First, we use the Breush-Pagan-Lagrange test, which leads us to strongly reject the null hypothesis of no panel effects (ordinary least squares(OLS) against random effects). Second, following the Hausman test, we reject the null of random effects versus fixed effects at more than 99 % confidence level; therefore we adopt a fixed effect approach. Third, Wald tests for heteroskedastcity also show that residuals are heteroskedastic. To correct this bias, we use Huber/White robust errors. We hence retain the regression with fixed effects in the following, although we also present the random effects estimations in Table 2. Indeed, the random effects regressions enable us to include constant bond-specific factors that provide a check for the consistency of the data.

All the coefficients have the expected signs. As regards the common determinants, the bond yields respond positively and significantly to the sovereign bond rate, the short-term interest rate and the volatility in the equity markets. Regarding the bond-specific variables, the residual maturity, the probability of default and the illiquidity proxy increase the bond yield as expected; the coefficients are significant at a 99% confidence threshold for all the variables in the three specifications. As structural bond characteristics are constant over time, they cannot enter the fixed effect regression but appear significant in both the random effects and OLS regressions. The yields of callable bonds are about 2 percentage points higher than the others, due to the higher risk born by the holder; this premium is meant to compensate the holder for the disadvantage of an early redemption. We have also tested for a specific effect for perpetual bonds but we do not report this coefficient in Table 2 as it was found not significant. This may be due to the fact that residual maturity already enters the equation, as we have set the residual maturity of all perpetual bonds to 50 years, in order to avoid missing values on this variable. Effects of the payment rank are not significant, probably because most of the portfolio consists of highly rated bonds with low probability of default.

Turning to the CSPP, we find a significant effect on the eligible bonds at the time of the announcement in March 2016. It causes their yield to fall by approximately 4 to 5 basis points in both regressions with fixed and random effects. Indeed, at the announcement time, two coefficients are at play: for the eligible bonds (-27.92) and for all bonds (+23.54) and must be added to get the total impact on the eligible bonds. This result confirms those found by Abidi and Miquel-Flores (2018) and De Santis et al. (2018) on a euro area sample. We also evidence that the effects are significant up to 11 months after the announcement. This complements the results of the previous studies that did not report lagged effects after the announcement. The estimated lagged coefficients are all negative up to 11 months, showing that the CSPP did succeed in lowering the corporate bond rates for the set of eligible bonds; the average decline in yield amounts to 10 bp over this 11-month period. The structure of the lags shows that the impact on yields is the strongest at the time of the announcement and peaks again between the two to four months after the effective implementation in June 2016. It then progressively wipes out before turning non-significant after one year. In the following, we therefore keep the dummy variables on the CSPP for eligible bonds with the 11 significant lags.

Table 2: Estimations with control variables, bond yield as dependent variable[1]

VARIABLES	Fixed effects		Random effects	
	yield	yield	yield	yield
Long rate	0.5868***	0.5802***	0.6467***	0.6409***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Short rate	0.6844***	0.6846***	0.7705***	0.7591***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Vstoxx	0.0175***	0.0172***	0.0210***	0.0206***
	[0.0016]	[0.0020]	[0.0001]	[0.0001]
VIX	0.0125**	0.0132**	0.0098**	0.0107**
	[0.0134]	[0.0111]	[0.0406]	[0.0286]
Residual maturity	0.0102***	0.0100***	0.0041***	0.0040***
	[0.0014]	[0.0026]	[0.0051]	[0.0063]
Proba of default	0.2319***	0.2346***	0.2269***	0.2296***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
liquidity	0.7074***	0.7058***	0.7513***	0.7491***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Coupon			0.4840***	0.4805***
			[0.0000]	[0.0000]
Callable			2.1780***	2.1858***
			[0.0000]	[0.0000]
CSPP		-0.2792**		-0.3035**
		[0.0408]		[0.0262]
cspp_1		-0.1395***		-0.1628***
		[0.0018]		[0.0002]
cspp_2		-0.0027		-0.0168
		[0.9547]		[0.7173]
cspp_3		-0.1073*		-0.1155**
		[0.0633]		[0.0441]
cspp_4		-0.1658**		-0.1634**
		[0.0209]		[0.0204]
cspp_5		-0.1082		-0.1094*
		[0.1000]		[0.0887]
cspp_6		-0.1086*		-0.1140**
		[0.0649]		[0.0477]
cspp_7		-0.2031***		-0.2236***
		[0.0000]		[0.0000]
cspp_8		-0.1621***		-0.2129***
		[0.0003]		[0.0000]
cspp_9		-0.1274***		-0.1684***
		[0.0032]		[0.0000]
cspp_10		-0.0677		-0.1351***
		[0.1490]		[0.0006]
cspp_11		-0.1076**		-0.1655***
		[0.0130]		[0.0000]
cspp_12		0.0185		-0.0498
		[0.6745]		[0.1945]
cspp_all		0.2354**		0.2480**
		[0.0386]		[0.0295]
Observations	13,876	13,876	13,876	13,876
R-squared	0.5960	0.5968		
Number of isin_id	393	393	393	393

(1) Long rate: French 10-y sovereign rate; short rate: 3-month Euribor; Prob of default: probability of default of each bond extracted from Bloomberg; Liquidity: bid-ask spread; Callable and Perpetual: dummies for these types of bonds. Hausman test show that fixed effects dominate the random effects regressions. CSPP is a dummy variable for all CSPP –eligible bonds at the announcement, March 2016. cspp_X corresponds to X lag of the CSPP variable. Cspp_all is a dummy for all bonds in the sample at the announcement. Robust p-values in brackets, *** p<0.01, ** p<0.05, * p<0.1

Concerning the CSPP non-eligible bonds, our results do not show a clear-cut effect, except that their yields tended to increase at the time of the CSPP announcement. This could be due to expectations of rising prices on the eligible bonds, leading investors to sell other bonds. Only the month of announcement is significant in the regression, none of the 12 lags are; hence only the contemporaneous variable is reported in Table 2. However, this temporary effect at the announcement is not significant in the OLS regression. Moreover, the dynamic panel estimations show the opposite sign. Abidi and Miquel-Flores (2018) find similar results on non-eligible bond yields for the euro area, while evidencing some positive effects of the CSSP through increased new issuances for all corporates. Taking into account all these results, we consider that there are no clear-cut evidence on the non-eligible bonds and thus remove the variable $CSSP\_all_{it}$ from the following regressions.

4.2 Main results: The Impact of net inflows in the FBF

We start from the benchmark regression with fixed effects including only the significant control variables and add our variables of interest successively in the regression. The results are displayed in Table 3.

First, we add the relative net inflows as an explanatory variable. The coefficient of the net relative inflows is significantly negative at a 99% confidence level (Column 1, Table 3). We conclude that the flows have an impact on the bond market as expected. The coefficient of 0.109 gives the order of magnitude of this effect: an inflow amounting to 1% of the funds' assets reduces the yield to maturity by about 11 bps. To gauge the impact in euros, we have to use the FBFs' average net assets over the period, which is € 530 bn. Hence a 1% relative inflow is roughly €5 bn. The size of the coefficient means that each billion of euros flowing into the FBF causes the yield to fall by about 2 bp. We have tried to introduce non –linearities such as (i) different thresholds at 0.5% or 1%; (ii) the quadratic inflows multiplied by 1 or (-1) according to their sign , but these terms were not found significant.

The effect of net inflows on yields can be merely interpreted as a "demand effect" in the sense that more inflows (outflows) mean more quantities bought (sold) by funds, which exert a direct upward (downward) pressure on prices. This straight effect is not specific to funds, as investors that put money into the FBFs (or withdraw it) may have the same effect if they bought (or sold) the same quantities of bonds directly. Moreover, the presence of funds in the bond market may amplify this direct price effect in two ways: (i) funds may be bigger than individual investors therefore when buying/selling securities their positions on the market may be more concentrated on fewer securities than individual owners who may not necessary buy/sell exactly the same securities at the same time. (ii) A signal effect may be as well at play, as funds' transactions on the market release some information to the market. Indeed, bond funds' behavior is quite different from the other major buyers such as insurance companies or pension funds. The latter often follow a buy-and-hold-to-maturity strategy, buying bonds at the issuance and keeping them until maturity; in this case, bonds never change hands, which explains their low liquidity in the secondary market. Bond mutual funds are atypical in this landscape, since they may pursue a more active management strategy. At least some of them perform a number of transactions in order to benefit from the market trends. According to Anand et al. (2017), the funds that tend to supply liquidity to the market, i.e. increase their bond holdings concomitantly with dealers' inventories, get a better performance on average, measured by the alpha of the fund's return. In this context, those funds are likely to be regarded as informed agents, and their transactions may be seen as revealing information. This information channel is all the more important when there are only few transactions in this market. Consequently, when there are unexpected inflows (outflows) to the funds, and bond funds are compelled to buy (sell) bonds, these transactions may release signals of buying (selling) and bring in their wake other players in the market.

Table 3: Estimation results [1]

	Control	H1	H2	H3	H3'	H4	H5
Long rate	0.5806***	0.5538***	0.5452***	0.5528***	0.5510***	0.5607***	0.5613***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Short rate	0.6842***	0.6776***	0.6791***	0.6214***	0.6219***	0.5872***	0.5928***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Vstoxx	0.0172***	0.0138**	0.0127**	0.0129**	0.0128**	0.0144***	0.0107
	[0.0020]	[0.0161]	[0.0252]	[0.0197]	[0.0205]	[0.0099]	[0.1205]
VIX	0.0132**	0.0129**	0.0138***	0.0153***	0.0153***	0.0137***	0.0136***
	[0.0111]	[0.0127]	[0.0067]	[0.0034]	[0.0033]	[0.0086]	[0.0088]
residual maturity	0.0099***	0.0109***	0.0110***	0.0102***	0.0103***	0.0105***	0.0105***
	[0.0024]	[0.0011]	[0.0009]	[0.0020]	[0.0019]	[0.0015]	[0.0016]
Proba of default	0.2347***	0.2349***	0.2342***	0.2341***	0.2349***	0.2345***	0.2348***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Liquidity	0.7057***	0.7035***	0.7032***	0.7371***	0.7369***	0.6689***	0.6668***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Share funds (-1)				-1.7063	-2.1435*	-2.1943*	-2.9101**
				[0.1407]	[0.0624]	[0.0557]	[0.0330]
CSPP	YES***	YES***	YES***	YES***	YES***	YES***	YES***
Flows		-0.1092***	-0.0686**	-0.0279	-0.0972***	-0.1025***	-0.1046***
		[0.0000]	[0.0137]	[0.3700]	[0.0021]	[0.0013]	[0.0010]
Outflows			-0.0889**	-0.0845*	0.0745	0.2776**	0.2671**
			[0.0391]	[0.0577]	[0.2046]	[0.0206]	[0.0253]
Flows*Share funds (-1)				-0.3836**	0.2905*	0.2790	0.3040*
				[0.0128]	[0.0890]	[0.1028]	[0.0744]
Outflows*Share funds (-1)					-1.5773***	-1.5748***	-1.4690***
					[0.0009]	[0.0009]	[0.0007]
Outflows*Liquidity						-0.2611*	-0.2614*
						[0.0557]	[0.0547]
Vstoxx*Share funds (-1)							3.5745
							[0.3169]
Observations	13,876	13,876	13,876	13,352	13,352	13,352	13,352
R-squared	0.5968	0.5998	0.6000	0.5901	0.5908	0.5928	0.5930
Number of isin_id	393	393	393	385	385	385	385

*[1] Estimation of Models (1) to (5). Long rate: French 10-y sovereign rate; short rate: 3-month Euribor; Prob of default: probability of default of each bond extracted from Bloomberg; Liquidity: bid-ask spread; CSSP are the lags ot the CSPP variable shown in Table 2; Flows are the relative flows to funds calculated by Equation (2); Flows*share_funds is the interactive variable between flows and the share of funds in each bond market defined in Equation (2); Negative_Flows*share_fund is the negative part of the previous variable. Negative_Flows*Liq is the interactive variable between the redemptions (negative part of flows) and bond liquidity (bid-ask-spread). Vstoxx*share_funds is the interactive variable between the Vstoxx and the share of funds in each bond market. Robust p-values in brackets, *** p<0.01, ** p<0.05, * p<0.1*

Second, we test for asymmetric effects of inflows or outflows by including the negative part of the flows into the regression. The coefficient on outflows is significant and negative (Table 3, Column 2). As outflows are negative, the minus sign means that they exert an upward pressure on yields, as expected. Coefficients show a rather strong asymmetry: 1% relative inflows reduces the yield-to-maturity by 7 bps only, whereas a 1% outflows raises it by 16 bps (=-0.0686-0.0889). A €1 bn withdrawal thus implies a raise in the yield by 3 bp.

This asymmetric effect raises concerns about financial stability and supports the materiality of asset fire sales as a channel of shock amplification. This price effect together with the sensibility of flows to bad fund performance may reinforce each other and bring a threat to the stability of the system. Indeed, Goldstein et al. (2017) have shown that unlike for equity funds, the flows-to-performance relation of bond funds is concave meaning that redemptions following bad performance are greater than the inflows resulting from good results. The problem for financial stability is that bad performance and redemptions may fuel each other in a vicious circle. And the bond market may be badly affected in times of crises.

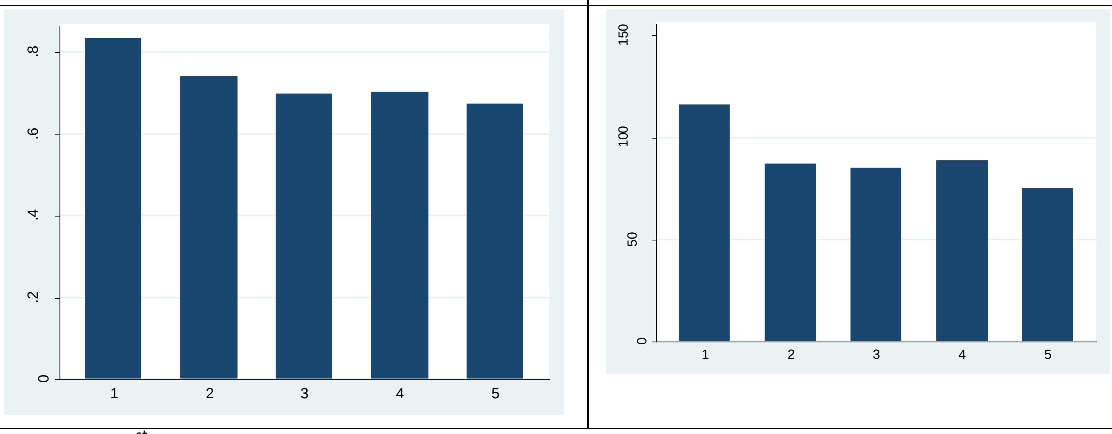
Third, we test for a differentiated impact of the funds according to their holdings in the market, by adding an interactive variable equal to the relative flows multiplied by the share of each bond market held by funds into the regression (Table 3, Column 3). This variable is significant at a 95% level. In other words, the mere buying (selling) by the funds due to the in(out)flows is able to exert strong pressures on the market price (and the yield), all the more due to their holding a substantial market share. This situation makes the market of these securities especially reactive to funds' behavior. Given the asymmetric effect evidenced in the previous regression, we add an interactive variable taking into account the market share of the funds combined with the outflows, instead of all the flows. Results strongly confirm the asymmetric effect. The bonds that are more owned by the funds have their yields increased more by outflows than those that are less detained and this difference is significant. '.

This result suggests that high concentration of funds in an asset may have disturbing effects on the asset price and make it more vulnerable to shocks. This finding interacts with the idea of stock price fragility proposed by Greenwood and Thesmar (2011) who claim that stocks with concentrated ownership experience higher price volatility.

Fourth, we next test for a possible impact on the liquidity premia when funds face redemptions through an interactive variable between liquidity and the withdrawals from funds. The interactive variable is found significant only at a 93% level. As negative flows ϕ_t^- are negative and *Liq* measures illiquidity, this negative sign means that redemptions tend to increase yields more for the less liquid bonds. This effect can stem from funds trying to ditch their less liquid bonds, when facing redemptions. To check this effect, we consider the set of bonds sold during the redemptions periods and we split it into quintiles. For each quintile, we calculate the mean liquidity and residual maturity, The results are pictured on Figure 6. The first quintile includes the bonds that are the most sold in percentage of funds 'holdings during these periods, some of them being entirely liquidated. On the whole, the figure shows that funds tend to sell more the most illiquid bonds, as well as those with the longer maturity.

Figure 6. Average liquidity and residual maturity of the sold bonds during redemption periods, by quintile.

Liquidity, bid ask pread, in %	Residual maturity, in months*



Note. The 1st quintile stands for the bonds that are the most sold by the funds in percentage of their holdings. * To avoid dropping perpetual bonds from the sample, we have set their maturity to 50 years, Lastly, we test if larger fund holdings adversely affect the bond yields in periods of stress by estimating regression (Model 5). The results in the baseline specification are not significant, however as shown in the robustness checks, they are significant at 5% level in a dynamic panel specification. Therefore our results only partially correspond to the findings of the IMF (2015) that indicate a positive relationship between ownership concentration of U.S. corporate bonds and the change in their credit spreads between 2008:Q2 and 2008:Q4. This result may suggest that during a stress period funds may want to reallocate their portfolio either to raise cash or to reduce exposures to riskier bonds. As put forward by the previous finding on the liquidity premia, it is potentially less liquid and riskier bonds that funds tend to sell. In our study, these two results are fragile, but if confirmed they do bring attention to the effects that such behavior may have for financial stability.

5. Robustness checks

We now proceed to several types of robustness checks. First, we use a different econometric specification through dynamic panel data estimations. Then, we adopt alternative definitions of our variable of interest in the regressions, namely the relative flows in the FBF. Finally we address some possible endogeneity issues.

5.1. Dynamic specification

As robustness tests, we run the same regressions as previously by using dynamic panel data estimations instead of static fixed effects. This allows us to avoid endogeneity problem; this also makes sense because there is a strong autoregressive component in the formation of bond yields. Given that the sample includes more panels than time periods and is subject to heteroscedasticity, we turn to the Arenallo-Bond estimations. However, we have found the residuals of these estimations autoregressive at the first and second orders, which invalidates the approach. We hence retain the Arellano-Bover/Blundell-Bond procedure. In this latter specification, the autocorrelation pattern of the residuals shows no evidence of misspecification when including one lag on the dependent variable. All coefficients are significant with the expected signs.

The estimations confirm our previous findings (Table 4). First, the flows entering the funds exert a significant downward pressure on the yields at a 99% confidence level, which comforts the former results (Column H1). Second, the effect is strongly asymmetric, as redemptions raise yields to maturity significantly at 99% level of confidence, whereas inflows are no longer significant (Column H2). Third, redemptions exert a stronger effect on the bonds that are more owned by the FBFs, as shown by the interactive variable of the flows multiplied by the share of funds in the bond market which is significant (Column H3'), although the effect is not significant in case of inflows (Column H3). The large ownership of bonds by funds has then an impact on the bond market only in times of outflows. In other words, the more the funds hold of a bond, the higher the increase in its yield in times of withdrawals. This situation seems rather detrimental as it is not compensated by the benefit of lower rates in times of inflows.

Table 4: Dynamic panel data regressions [(1)]

	Control	H1	H2	H3	H3'	H4	H5
yield(-1)	0.8600***	0.8591***	0.8590***	0.8608***	0.8605***	0.8584***	0.8570***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Δ Long rate	0.2911***	0.2752***	0.2544***	0.2500***	0.2486***	0.2534***	0.2462***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Δ Short rate	0.4015***	0.1887	0.1946	0.2735*	0.2757*	0.1997	0.2009
	[0.0022]	[0.1389]	[0.1229]	[0.0623]	[0.0603]	[0.1641]	[0.1706]
Δ Vstoxx	0.0130***	0.0129***	0.0133***	0.0125***	0.0123***	0.0123***	0.0111***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Vstoxx	0.0027	0.0011	-0.0005	0.0012	0.0015	0.0031	-0.0019
	[0.3804]	[0.7237]	[0.8863]	[0.7409]	[0.6672]	[0.3895]	[0.6000]
VIX	0.0112***	0.0123***	0.0124***	0.0128***	0.0128***	0.0106***	0.0108***
	[0.0001]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0003]	[0.0002]
Liquidity	0.2277***	0.2331***	0.2352***	0.2353***	0.2361***	0.1886***	0.1954***
	[0.0038]	[0.0034]	[0.0033]	[0.0044]	[0.0044]	[0.0089]	[0.0076]
Δ Probability of default	0.1285***	0.1142***	0.1147***	0.1145***	0.1128***	0.1040***	0.0992***
	[0.0014]	[0.0033]	[0.0031]	[0.0029]	[0.0031]	[0.0051]	[0.0070]
Share_funds(-1)				-0.5359	-0.6133	-0.2875	-0.8784
				[0.3939]	[0.3245]	[0.6347]	[0.1715]
CSPP	YES***	YES***	YES***	YES***	YES***	YES***	YES***
Flows		-0.0644***	-0.0104	-0.0025	-0.0300	-0.0263	-0.0070
		[0.0000]	[0.5674]	[0.8939]	[0.1599]	[0.1982]	[0.7060]
Outflows			-0.1199***	-0.1202***	-0.0563	0.0976	0.0444
			[0.0006]	[0.0006]	[0.1836]	[0.1572]	[0.4981]
Flows*Share_funds(-1)				-0.0368	0.2506**	0.2059*	0.0974
				[0.4819]	[0.0370]	[0.0669]	[0.3150]
Outflows*Share_funds(-1)					-0.6593**	-0.5218*	-0.1761
					[0.0435]	[0.0929]	[0.5072]
Outflows*Liquidity						-0.2214***	-0.2076***
						[0.0064]	[0.0084]
Vstoxx*Share_funds(-1)							6.8343**
							[0.0242]
Observations	13,471	13,471	13,471	13,314	13,314	13,314	13,314
Number of ISIN	390	390	390	385	385	385	385

[(1)] Estimation of Models (1) to (5) with the Arellano-Bover/Blundell-Bond procedure. Residuals are found not autocorrelated at an order greater than one. Long rate: French 10-y sovereign rate; short rate: 3-month Euribor; Prob of default: probability of default of each bond extracted from Bloomberg; Liquidity: bid-ask spread; Flows are the relative flows to funds calculated by Equation (2); Flows*share_funds is the interactive variable between flows and the share of funds in each bond market defined in Equation (2); Negative_Flows*share_fund is the negative part of the previous variable. Negative_Flows*Liq is the interactive variable between the redemptions (negative part of flows) and bond liquidity (bid-ask-spread). Vstoxx*share_funds is the interactive variable between the Vstoxx and the share of funds in each bond market. Robust p-values in brackets, *** p<0.01, ** p<0.05, * p<0.1

Fourth, the dynamic regressions validate the hypothesis that redemptions affect more illiquid bonds than others (Column H4), at a level of confidence of 99% instead of 93% in the previous results. This effect is on the top of the standard liquidity premium that is captured by the liquidity proxy in the control variables and raises yields. Lastly, the equity market volatility, measured both by the Vstoxx and the VIX, raises the bond yields across the board as shown in the control variables. On the top of this effect, we find significant differences across the bonds that are more or less detained by funds (Column H5). The more bonds are detained by funds, the more their yield tends to rise with the volatility of equity market.

5.2 Alternative definitions of relative flows

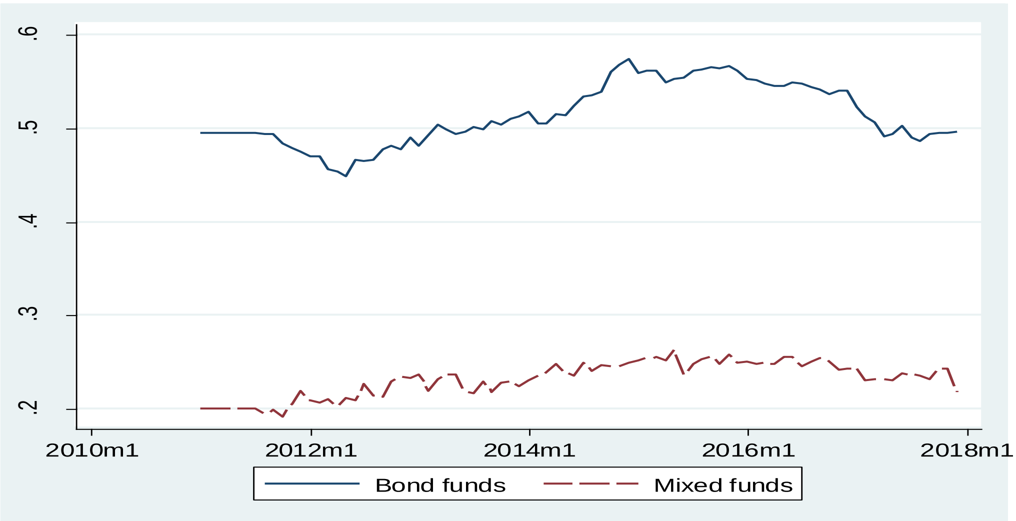
As the relative flows are the key variable to our analysis, we test alternative specifications of the ratio in the same estimations. Until now, we have defined it as the total flows in the FBF divided by the total net assets under management, as stated by Equation (2), both flows to bond and mixed funds being aggregated in the definition. This definition could be criticized on the grounds that flows to bond and mixed funds are indistinctly aggregated, although their type of allocation is quite different. Indeed, flows pouring into bond funds are allocated mainly in bonds, whereas only a small fraction of flows entering into the mixed funds are invested into bonds.

We hence propose two alternative measures of the relative flows to address this issue. We extract the net flows entering into the funds F_t^B, F_t^M and compare them to the total funds' net assets under management A_{t-1}^B, A_{t-1}^M for each category of funds *B* or *M.* The four time-series are depicted in Figure 1. We then calculate the shares of bonds in the total assets held by each category of funds:

$$\rho_{tk} = \frac{B_{t-1}^k}{A_{t-1}^k}. \quad (3)$$

Where ρ_t^k denotes the share of bonds in the total net assets of type k funds, B_t^k; the total amount of bonds detained by type k fund, calculated by aggregating all the bonds in our database by type of funds, and A_t^k , the assets under management of type k funds of type k. These shares as rather stable over the period, around 50% for the bond funds and 20% for the mixed funds (Figure 7).

Figure 7. Share of bonds in the total net assets of mixed and bond funds



We can now proxy the amount of flows likely to be invested into bonds as the sum of the observed flows at time t weighted by these shares at time t-1: $\rho_{t-1}^B F_t^B + \rho_{t-1}^M F_t^M$. This gives us the first alternative measure of relative funds φ'_t , which is equal to the amount of flows likely to be invested into bonds divided by the total net assets under management by both funds (and taken as a percentage).

$$\varphi'_t = 100 * \frac{\rho_{t-1}^B F_t^B + \rho_{t-1}^M F_t^M}{A_{t-1}^B + A_{t-1}^M} \quad (4)$$

Another alternative measure of relative flows will assign fixed weights of 50% for bond funds flows and 20% for mixed funds. This makes sense as the share of bonds in the total assets of both types of funds is rather stable through time around these values.

$$\varphi''_t = 100 * \frac{0.5F_t^B + 0.2F_t^M}{A_{t-1}^B + A_{t-1}^M} \quad (5)$$

We then rerun all the estimations with these alternative measures of relative flows. Table 5 summarizes all the obtained results. All the above results are confirmed, with approximately the same level of confidence.

Table 5. Robustness tests with alternative specifications of the relative flows. [(1)]

	Tested hypotheses	Fixed effects			Dynamic Panel		
		Flows Total	Flows' Var weights	Flows '' Fixed weight	Flows Total	Flows' Var weights	Flows '' Fixed weight
H1	Relative flows have an impact on YTM	YES / 99%	YES / 99%	YES / 99%	YES / 99%	YES / 99%	YES / 99%
H2	Asymmetry : greater impact of outflows	YES / 96%	YES / 97%	YES/ 95%	YES / 99%	YES / 99%	YES / 99%
H3	Stronger impact of flows for bonds more held by funds	YES / 98%	YES / 98%	YES / 99%	NO	NO	NO
H3'	Stronger impact of outflows for bonds more held by funds	YES / 99%	YES / 99%	YES / 99%	YES/95%	YES / 99%	YES / 99%
H4	Stronger impact of outflows on the less liquid bonds	YES/ 94%	*YES/ 90%*	NO	YES/ 99%	YES/ 99%	YES/ 98%
H5	Stronger impact of financial stress for the bonds that are more held by funds	NO	NO	NO	YES / 97%	YES / 98%	YES / 97%

[(1)] The hypotheses are accepted (yes) or not (no) with levels of confidence. *Flows* are net flows as a percentage of assets under management (Equation 2); *Flows'* and *Flows''* are the average of flows entering the bond and the mixed funds weighted by the share of bonds in the assets under management of the two types of funds; *Flows'* has a variable weighting (Equation 4); *Flows''* has a fixed weighting (Equation 5).

5.3 Other possible endogeneity issues

Flows are known to be linked to the FBF's past performance flows (Ippolito, 1992; Sirri and Tufano, 1993). If in turn, past performance is good predictor for future returns, the equations explaining returns by flows may be subject to endogeneity issues. In our case, this problem is greatly alleviated since our dependent variable is the yield to maturity of bonds, not the return on funds. Moreover, we deal with the French corporate bonds only, whereas the flows into funds are allocated mostly into sovereign and foreign bonds. Hence, the corporate bond yield is not likely to drive investors' decisions to inject/withdraw cash in the funds. Besides, studies have shown that flows do not predict future returns in the case of equity funds; on the contrary, stocks bought by funds have a tendency to have lower returns than the others (Frazzini and Lamont, 2008).

Nevertheless, a way of addressing this issue is to extract the unexpected component in the funds' net flows, or "surprises", ϕ_t^S by following a common approach (see, e.g., Edelen and Warner (2001), Acharya et al. (2014)). The "surprise" net flows are obtained as the residuals of the regression of the flows ϕ_t^S on their lagged values and the lagged performances of funds. Performance is measured as the monthly valorization divided by funds' outstanding assets in the previous month. Two lags or three lags are retained in the regression. The results show that the unexpected component of flows is very close to the observed flows. Consequently, when we replace the relative flows by their unexpected components and rerun the regressions, the results are very similar; in particular, it does not change the tests on the hypotheses.[2]

[2] Results are not reported for the sake of brevity but are available from the authors.

6. Conclusion

In this paper, we analyze the potential effects exerted by the French bond and mixed mutual funds (FBF) on the corporate bond market, using Bank of France data on their holdings and flows. The question of fund flows and price effect has been studied in the literature but mostly for equity funds. However, given lower liquidity of corporate bonds market and the growing size of asset management industry, the analysis of the effect of fund flows on corporate bond prices is of particular importance for financial stability.

We test for several hypotheses using panel regressions at the bond-level through different estimation methods. First, we find that net fund flows significantly affect bond yields to maturity; more specifically, when funds face inflows (outflows), bond yields tend to decrease (increase). Second, we show that this effect is strongly asymmetric as the investors' withdrawals from FBF have more adverse effects in increasing bond yields than inflows have favorable ones in alleviating them. Third, the price effect is stronger for those bonds that are held by funds to a larger extent. The more a bond is detained by funds, the more its yield is sensitive to redemptions. These results are robust to different specifications as well as alternative definitions of the relative flows entering the funds. Besides, two other results emerge from the dynamic panel estimations as strongly significant, although they are not evidenced by the fixed effects regressions. We find that outflows tend to raise liquidity premia above the standard effect of liquidity. Moreover, bonds that are the most detained by funds are more sensitive to financial volatility.

Some policy implications can be drawn from this study. First, due to large holdings of assets by funds, price effects of asset liquidation may not be neutral in illiquid markets such as corporate bonds. Second, the larger the funds' holdings in a certain asset the larger is the price effect, thus particular attention should be paid to the concentration of asset holdings by one institution or one type of institutions. The traditional diversification notion concerns agent's portfolio and is meant to avoid specific risk. We suggest that diversification of holders of a certain asset may be a way forward to avoid significant price effects. In this perspective, more studies are needed at the fund level to understand funds' behavior when facing significant outflows.

REFERENCES

Abidi, N. and Miquel-Flores, I. (2018). Who benefits from the corporate QE? A regression discontinuity design approach. ECB, Working Paper n° 2145, April 2018.

Acharya, A., Anshuman, R., and Kumar, K. "Foreign Fund Flows and Stock Returns: Evidence from India." Working paper, New York University.

Anand, A., Jotikasthira, C., Venkataraman, K. "Do Buy-Side Institutions Supply Liquidity in Bond Markets? Evidence from Mutual Funds", 28th Annual Conference on Financial Economics and Accounting, SMU Cox School of Business Research Paper No. 18-5.

Bao, J., Pan, J., and Wang, J., 2011. "The illiquidity of corporate bonds", *Journal of Finance*, vol 66, issue 3,p. 911-946

Baranova, Y., Becker, S., Grillet-Aubert, L., and T.S. Pinheiro. 2018. "Investment fund stress testing – a macroprudential perspective". ESRB OP 2018.

Bellando, R., and Tran-Dieu, L.T., 2011. « Fund flow/performance relationship: a case study of French mutuals funds". Revue Economique n°.2

Ben-Raphael, A., S. Kande, and A.Wohl. 2011. "The Price Pressure of Aggregate Mutual Fund Flows." *Journal of Financial and Quantitative Analysis* 46 (2): 585–603.

Chernenko, S., and Sunderam, A. 2016. “Liquidity transformation in asset management: Evidence from the cash holdings of mutual funds”, Fisher College of Business Working Paper, 2016.

Chevalier, J.A., and Ellison, G.D. 1997. “Risk-taking by mutual funds as a response to incentives”, The Journal of Political Economy, 105(6), pp 1167-1200

Choi, J., Kronlund, M. 2018. Reaching for Yield in Corporate Bond Mutual Funds. The Review of Financial Studies, Volume 31, Issue 5, 1 May 2018, Pages 1930–1965

Coudert, V., Couharde, C., and Mignon, V., 2011. Exchange rate volatility across financial crises”, Journal of Banking & Finance, Volume 35 (11), November, p. 3010-3018.

Coval, J., and E.Stafford. 2007. “Asset Fire Sales (and Purchases) in Equity Markets.” *Journal of Financial Economics* 86 (2): 479‑512.

Dastarac, H.

De Santis, R, A. Geis, A. Juskaite and L. Vaz Cruz. 2018. “The impact of the corporate sector purchase programme on corporate bond markets and the financing of euro area non-financial corporations”, European Central Bank Economic Bulletin, Issue 3 / 2018.

Edelen, Roger. 1999. “Investor Flows and the Assessed Performance of Open-end Mutual Funds.” *Journal of Financial Economics* 53 (3): 439‑66.

Edelen, R. and J. Warner. 2001. “Aggregate Price Effects of Institutional Trading: A Study of Mutual Fund Flow and Market Returns.” *Journal of Financial Economics* 59: 195‑220.

Feroli, M., Kashyap, A.K., Schoenholtz, K.L. , Shin, H.S. , 2014. In: Morgan Chase, JP (Ed.), Market tantrums and monetary policy. University of Chicago, New York University and Bank of International Settlements. Unpublished working paper.

Fourel, J. and V. Potier, 2015. Fonds d’investissement non monétaires français. Faits saillants pour l’année 2014 et le premier trimestre 2015. Bulletin de la Banque de France, 3e trimestre 2015.

Frazzini, A., Lamont, O.A., 2008. Dumb money: mutual fund flows and the cross-section of stock returns. Journal of Financial Economics 88, 299–322.

Goldstein, I., Jiang, H., Ng, D., 2017. “Investor flows and fragility in corporate bond funds”, Journal of Financial Economics, vol. 126 (3), pages: 592-613.

Greenwood,R., Thesmar,D.,(2011) Stock price fragility. .Journal of Financial Economics, doi:10.1016/j.jfineco.2011.06.003

Han S., Zhou H. 2016. “Effects of liquidity on the non-default component of corporate yield spreads: evidence from intraday transactions data”, Quarterly Journal of Finance, 6 (2016), pp. 129-178

Huang, J., Wei, K.D., Yan, H. , 2007. “Participation costs and the sensitivity of fund flows to past performance”. The Journal of Finance 62, 1273–1311.

IMF 2015, Global Financial Stability Report , April, Chapter 3.

Ippolito (1992), Consumer Reaction to Measures of Poor Quality: Evidence from the Mutual Fund Industry, *Journal of Law and Economic*, 35(1) pp 45-70.

Jondeau & Rockinger (2004) “The Bank Bias: Segmentation of French Fund families” *Notes d’Etudes et de Recherches de la Banque de France* n°107.

Longstaff, F., Mithal, and S., Neis, E. 2005. "Corporate Yield Spreads: Default Risk or Liquidity? New Evidence from the Credit Default Swap Market," Journal of Finance, vol. 60(5), pages 2213-2253, October.

Lynch, A.W., and Musto, D.K., 2003. “How investors interpret past fund returns”. The Journal of Finance 58, 2033–2058 .

Manconi, A., Massimo, M., Ayako, Y. 2012 “The role of institutional investors in propagating the crisis of 2007–2008” Journal of Financial Economics 104 (2012) 491–518

Ponsard, M and Salvio, A. 2018. Investment Funds in the euro area : an heterogeneous dynamic since 2009. Bulletin de la Banque de Franec, 216/2. March-April.

Rey, H., 2016. “International Channels of Transmission of Monetary Policy and the Mundellian Trilemma”, IMF Economic Review, May 2016, Volume 64 (1), pp 6–35.

Standard & Poor’s (2018). 2017 Annual Global Corporate Default Study and Rating Transitions”. https://www.spratings.com/documents/20184/774196/2017+Annual+Global+Corporate+Default+Study/a4cffa07-e7ca-4054-9e5d-b52a627d8639

Sirri, Erik R., and Peter Tufano. 1998. “Costly Search and Mutual Fund Flows.” *Journal of Finance* 53 (5): 1589‑622.

Warther, V. A. 1995. “Aggregate Mutual Fund Flows and Security Returns.” *Journal of Financial Economics* 39 (2-3): 209‑35.

Zeng, Yao (2016). A Dynamic Theory of Mutual Fund Runs and Liquidity Management." ESRB Working Paper Series No 42 / April 2017