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Insurers' investment behaviour and the coronavirus (COVID-19) pandemic

by
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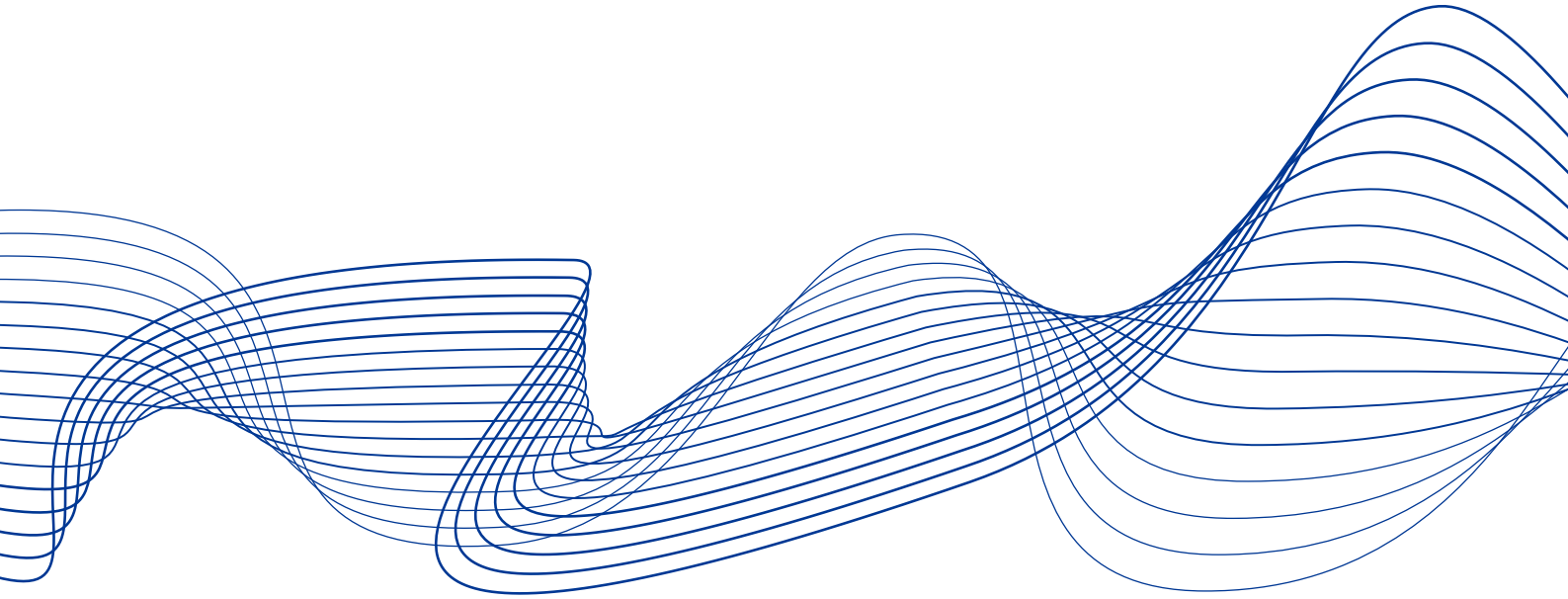

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Abstract

This research explores two aspects of European insurers' investment behaviour related to crises. While they are often considered as financial market stabilisers and long-term investors, there is currently a lack of knowledge about insurers' investment behaviour in crises under the regulatory Solvency II regime implemented in 2016. With assets of nearly €9 trillion and bond holdings of more than €3 trillion in Q2 2022, European insurers are important financial intermediaries and finance European economies. With an empirical study, we investigate their reaction to the asset price shock at the onset of the coronavirus (COVID-19) pandemic in the first quarter of 2020 and explore cyclical investment behaviour by replicating Timmer's (2018) study with fixed effects panel regressions. We use a large cross-country dataset, with the novelty of exploiting cross-country heterogeneity for European countries with 458,758 security-level observations from 2017 to 2022. Overall, our findings are very relevant from a policy perspective as they suggest active and heterogeneous cyclical investment behaviour in the European insurance market with differences across issuer and holder countries of domicile.

Keywords: Insurance Companies, Cyclicality, Portfolio Allocation, Financial Stability, Pandemic, Debt Capital Flows.

JEL Codes: G01, G11, G15, G22, G28.

Executive summary

In this paper, we explore two aspects of European insurers' investment behaviour related to crises. With an empirical study, we investigate their reaction to the asset price shock at the onset of the coronavirus (COVID-19) pandemic in the first quarter of 2020 and explore cyclical investment behaviour by replicating Timmer's (2018) study with fixed effects panel regressions. In line with other works (Fache Rousová and Giuzio, 2019b; Carvalho and Schmitz, 2021), we use a large, confidential cross-country dataset, with the novelty of exploiting cross-country heterogeneity for European countries with 458,758 security-level observations from the first quarter of 2017 to the second quarter of 2022. Insurance markets in Europe differ in terms of the type of savings products offered, insurers' capitalisation ranges[1] and investment strategies. For index-linked and unit-linked insurance, for example, policyholders bearing the investment risk account for between 6% and as much as 70% of total insurance assets.[2] Regarding capitalisation, the long-term guarantee (LTG) support measures under Solvency II (SII) improved average country-level solvency ratios up to 47 percentage points in 2019 (EIOPA, 2020b). Lastly, insurers in several countries have a home bias in their investments, for example when exposure to the domestic sovereign exceeds 80% of total holdings in government bonds (EIOPA, 2022).

With assets of nearly €9 trillion and bond holdings of more than €3 trillion, European insurers are important financial intermediaries and finance European economies.[3] While they are often considered financial market stabilisers and long-term investors, there is currently a lack of knowledge about insurers' investment behaviour in crises under the regulatory SII regime implemented in 2016. To the best of our knowledge, EIOPA (2021, 2022) and Brinkhoff and Solé (2022), who investigate European life insurers from 2005 to 2021, are the only authors to have studied a multi-period, cross-country sample since the introduction of SII. Other related studies are Bijlsma and Vermeulen (2016), Domanski, Shin and Sushko (2017), Timmer (2018), Carvalho and Schmitz (2021) and Apicella, Gallo and Guazzarotti (2022), who analyse shorter, pre-SII or single-country samples.

Notwithstanding the fact that our research refers to a period of low interest rates, our findings have policy implications beyond market cycles. First, we demonstrate that insurers are active and not buy-and-hold investors, given that they rebalanced their portfolios during the shock in the first quarter of 2020. Second, and over a longer period from the first quarter of 2017 to the second quarter of 2022, we find confirmation of active investment strategies in certain countries and situations. For example, our regression results point to countercyclical investments in Belgium and the Netherlands and – for government bonds – in Italy during the COVID-19 shock. The use of derivatives, product features, interconnectedness and national investment regulations may explain country-level differences. To better understand the drivers of this behaviour, company-level data are needed. Investigating such drivers (e.g., liquidity needs, solvency ratios or duration mismatch) are topics for future research.

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1 See Figure 2.15 in EIOPA (2022), p.40.

2 See **EIOPA Insurance Statistics** Solvency II reporting template S.06.02. solo quarterly, second quarter of 2022.

3 Kaufmann, Leyva and Storz (2022) show that euro area insurers held more than a quarter of total euro area corporate debt in the second quarter of 2021; see also Kubitza (2022).

1 Introduction

While the financial health of European insurers is fairly stable, it is unclear whether and how they react to asset price shocks. Since the implementation of the Solvency II (SII) regulation, insurers are expected to be more sensitive to such shocks as SII is a market-based regime. Accordingly, insurers must value their assets and liabilities based on market values, and negative shocks might hamper their balance sheets and solvency ratios. This is apparent when interest rates are low and the present value of insurers' liabilities is high. Against such a backdrop, some researchers have observed that insurers invest in riskier assets in search for yield.[4] At the same time, insurers must fulfil the solvency capital requirement to withstand shocks with a 99.5% probability over the next year. Solvency ratios describe the relationship between own funds and solvency capital requirements and must exceed 100%. Declining asset prices due to increases in risk spreads (ceteris paribus) lead to lower solvency ratios. To protect their solvency ratios against greater losses if asset prices were to fall further, insurers could potentially conduct large-scale asset sales in downturns, triggering fire sales and posing risks to financial stability.

There is currently little knowledge about the drivers of European insurers' investment behaviour, including solvency ratios and investment gains. The relationship between investments and solvency ratios is as follows: life and composite insurers predominantly invest in fixed income instruments to match the characteristics of their assets and liabilities. As the characteristics of assets and liabilities typically do not perfectly match, volatility in fixed income prices contributes to fluctuations in own funds and solvency ratios. An increase in credit spreads decreases own funds and may increase solvency capital requirements, leading to lower overall solvency ratios. Hence, insurers with solvency ratios close to the regulatory requirement have greater incentives to sell risky assets in crises. On the other hand, potential contributors to countercyclical investment behaviour are the capital support LTG measures, which aim to reduce the volatility of solvency ratios.[5] Another reason for selling assets are unrealised investment gains under national accounting laws.[6] These unrealised gains present buffers to support profits shared with life insurance policyholders. Other possible drivers for insurers' investment behaviour are liquidity needs, compliance with the defined investment strategy (e.g., triggering sales of downgraded bonds), business models and premium flows (Kubitza, 2022) as well as deliberate countercyclical investments.

This work is intended to contribute to the empirical research on European insurers' investment behaviour from a macroprudential perspective. First, we complement the emerging literature on the role of insurers as financial intermediaries by investigating their behaviour in

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4 See Fache Rousovà and Giuzio (2019a), FMA (2019), Deutsche Bundesbank (2021) and Becker and Ivashina (2015). Brinkhoff and Solé (2022) estimate that the search for yield accounted for about one-third of the total deterioration in credit quality of European life insurers' portfolios from 2005 to 2021.

5 Due to the mismatch of assets and liabilities, the volatility adjustment LTG measure can also lead to higher and more volatile solvency ratios, as observed in AT, BE and NL in the first quarter of 2020. See ESRB (2021), p. 111 and ESRB (2018), pp. 20-30.

6 It should be noted that, under French accounting rules, the result realised by insurers on bond sales does not directly affect financial results. Indeed, gains realised on such sales are booked in a reserve account (called a "capitalisation reserve"), while losses are offset by a decrease in this reserve. As a consequence, this mechanism significantly reduces fluctuations in the financial results of insurers, even in the event of significant variations in interest rates.

shocks. Insurers' investment decisions in crises can be triggered by many reasons, including margin calls (Fache Rousová, Ghio, Kördel and Salakhova, 2020), interconnectedness within the financial system (Billio et al., 2011; Baluch, Mutenga and Parsons, 2011; Jourde, 2022), intra-sector developments such as duration gaps (Domanski, Shin and Sushko, 2015; Timmer, 2018), company-specific characteristics such as low excess of assets-to-liabilities or solvency ratios (Van Binsbergen and Brandt, 2016; Banca d'Italia, 2021) or a combination of external and internal factors, including risk limits (Bijlsma and Vermeulen, 2016). In this respect we complement the works developing around the coronavirus (COVID-19). Carvalho and Schmitz (2021) focus on the portfolio shifts of euro area investors in the first and second quarters of 2020, also considering investments within funds. They find a strong preference for domestic sovereign debt. In the United Kingdom, Czech, Gual-Ricart, Lillis and Worlidge (2021) find insurers sell this asset class, leading to a sharp increase in trading volumes. In Italy, Apicella, Gallo and Guazzarotti (2022) show that only well capitalised insurers were able to act countercyclically in the first quarter of 2020. Our contribution to this literature is to take a country-level perspective by investigating a multi-period European sample of insurers in Austria, Belgium, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain from the first quarter of 2017 to the second quarter of 2022. Our sample is also new, as insurers under SII are no longer subject to regulatory quantitative investment rules but must abide by the prudent person principle in their investments.[7] With detailed descriptive statistics along several asset characteristic dimensions, we show changes in the composition of insurers' portfolios during the capital market shock in the first quarter of 2020, implying that they actively adjust them in response to short-term asset price movements. In the first quarter of 2020 they purchased and sold securities worth €680 billion, mainly focusing on government debt.

We further add to the literature by investigating whether and how European insurers behave procyclically in their investments. Following Timmer (2018), we define procyclicality as the selling or purchasing of securities in the period following a price decline or increase. Though traditionally considered countercyclical investors who purchase bonds in periods of falling prices, there is empirical evidence that insurers can amplify trends in bond prices (Duijm and Steins Bisschop, 2018; Domanski, Shin and Sushko, 2017). Fache Rousová and Giuzio (2019b) explain their behaviour with changes in interest rates and risk premia and find that the latter drive procyclical investment behaviour with the exception of domestic sovereign debt. Over a longer period from 2005 to 2021 and to the contrary, however, Brinkhoff and Solé (2022) find that European life insurers largely retained their buy-and-hold strategies. To the best of our knowledge, we are the first to replicate Timmer's (2018) study to assess the cyclical investment behaviour of European SII insurers in several countries. Timmer (2018) finds countercyclical behaviour for German insurers in his cross-sector study from the fourth quarter of 2004 to the fourth quarter of 2014. Following the author, we regress the percentage change in the nominal holding of a debt security held by insurers in a country on the security's lagged holding period return. In line with the literature (Bijlsma and Vermeulen, 2016; Fache Rousová and Giuzio, 2019b; Czech, Gual-Ricart, Lillis and Worlidge, 2021), we find procyclical investment behaviour in certain situations. These situations refer to market shocks, to the domicile of the insurer or bond issuer and to specific bond market segments.

[7] See Art. 132 of the **Solvency II Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II)**, 30.06.2021.

Our novel method complements aggregated descriptive statistics with regression analysis of 458,758 security-level observations. In a first step, we focus on the crisis in the first quarter of 2020 and compute aggregate and country-level descriptive statistics on transaction volumes, shifts between asset classes, ratings, maturities, and geographies. To better understand the counterparties of each trade, we compare insurers' investments with those of banks and investment funds. These two sectors showed higher turnover at the onset of the pandemic, with investment funds typically being net sellers and banks typically being net buyers. Furthermore, we consider matured bonds and the return of principal as a source of liquidity for insurers. To account for seasonality in premiums, we extend our analysis to the preceding and following quarters. In the second-step regressions, we aim to better understand whether and in which European insurance markets systemic risks from investments are more likely. Given their importance in insurers' asset allocations, and for this exercise, we focus on debt securities.

As illustrated in Chart 1a, bonds accounted for around 50% of European insurers' asset allocations before the COVID-19 pandemic, most of which were government bonds. In some Member States, the majority of these government bonds are domestic (Chart 1b). To gain new insights on the insurance-sovereign nexus[8] and to understand whether there is a "preferred habitat" (Giese, Joyce, Meaning and Worlidge, 2021) in insurers' transactions, we focus on government bonds in the regressions. To test whether insurers change their behaviour in shocks more formally, we introduce a COVID-19 dummy variable. For robustness, we conduct additional tests for samples of all bonds, and of financial and non-financial sector bonds separately. Our analysis concludes with an explorative study relating the solvency ratios of the 10% least capitalised insurers to investment behaviour.

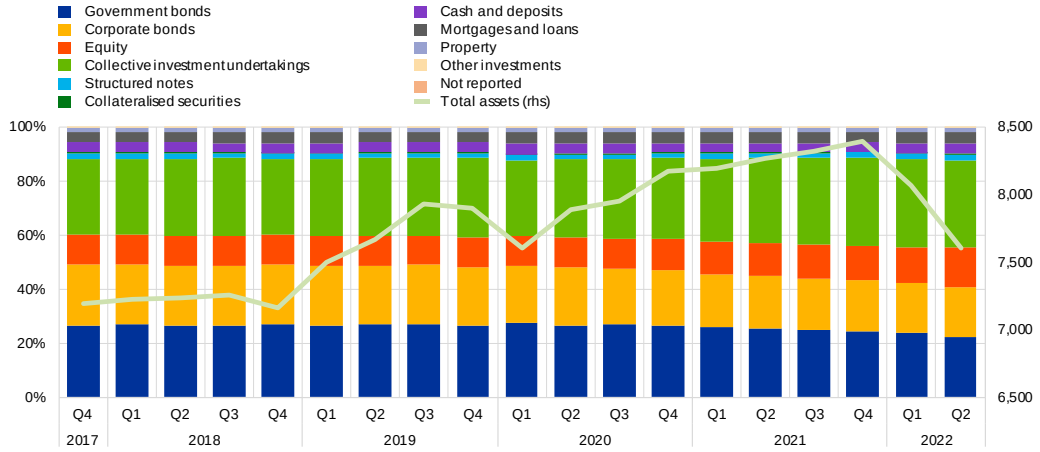
[8] See also Düll, König and Ohls (2017).

Chart 1

Asset allocation of European insurers

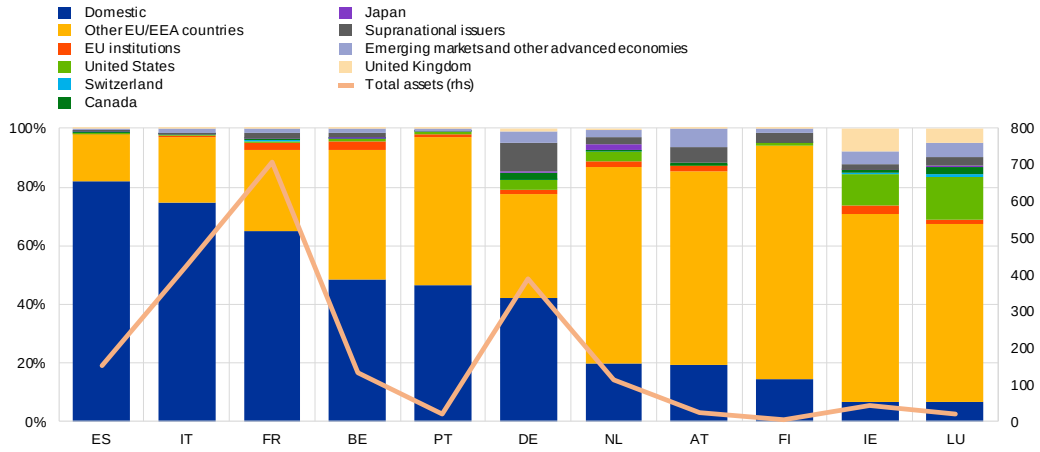
a) Asset allocation over time of European insurers

(percentages and EUR billion, fourth quarter of 2017 to second quarter of 2022)



b) Government bond holdings by domicile of the issuer

(percentages and EUR billion, fourth quarter of 2019)



Sources: Public EIOPA insurance statistics, Solvency II reporting template S.06.02. solo quarterly (panel a); and EIOPA (2020a; panel b).
Note: Panel a) refers to insurers in Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain.

Fixed effects panel data regressions best capture the stable characteristics of European insurance markets. These country-level characteristics comprise, for example, the share of index-linked and unit-linked insurance, insurers' investments via funds or national investment regulations,[9] which can affect insurers' investment behaviour and do not or only slightly change over time. These characteristics are captured by country-level fixed effects (FE) in our model. As explained in the data section (Section 2), our unit of observation are individual securities held by insurers in a country.[10] Our panel is unbalanced, as not all security-holder country combinations are held over the entire sample period. In addition, as there is no information on the specific insurance company holding the security, we cannot control for variables which vary at the insurer level, such as solvency ratios or index-linked and unit-linked business. However, since our aim is to strictly follow Timmer (2018), we do not need this information as we focus on security-level information and use a parsimonious regression approach. Furthermore, since our research relates to cyclical investment behaviour, we concentrate on a model that gains the regression estimates from the variation in variables over time. Thereby, in addition to country-level FE, we also control for security-level FE such as issuer country, duration, and credit quality, which may influence investment behaviour. The controls are implemented by a process of "demeaning" in the fixed effects regression, as deviations from the means of the individual securities at the holder country level are considered. Moreover, significant estimators in fixed effects models explain differences in insurers' investment behaviour for individual security-holder country pairs from one quarter to the next ("within estimator").

Our results provide evidence for policy conclusions on insurers' long-term investments and liquidity risk. Insurers are broadly considered as long-term buy-and-hold investors. We show that some SII insurers invest procyclically in government and in financial sector bonds, which can affect the liquidity of markets and "liquid" assets such as money market funds (MMFs). We also find indications of a preference for domestic government bonds and for asymmetric behaviour in market downturns as compared with market upturns (see also Duijm and Steins Bisschop, 2018). An important ancillary finding of our analysis is that European insurers invest substantially in bonds which are neither listed nor actively traded. This points to liquidity needs as another driver of insurers' investment behaviour observed in the first quarter of 2020.

This paper is organised as follows: Section 2 describes the data, Section 3 shows the descriptive results, Section 4 the regressions and Section 5 concludes. Additional analyses and further explanatory notes on the methodology to retrieve the dataset are set out in the annex.

[9] See, for example, **Insurance Undertaking Investment Regulation (Versicherungsunternehmen Kapitalanlageverordnung - VU-KAV)** BGBL II Nr. 423/2015, which provides requirements for insurers' investments in accordance with the prudent person principle (see also Art. 132 of the SII directive).

[10] Insurers in several countries also often hold the same securities over different periods.

2 Data

Our sample comprises data for all euro area insurance markets with assets larger than €50 billion in Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. The security-level data of the ECB's Securities Holdings Statistics by Sector (SHSS) provide confidential quarterly information on the securities holdings of euro area investors at the holder country and sector level.[11] The analysis of SHSS data allows for a comparison of the investment behaviour of insurers with that of other financial intermediaries and has the advantage of providing granular, security-level data focusing typically on more liquid assets in insurers' portfolios. The data do not include information about individual insurers or insurance business lines, and our sample is therefore a composite of life and non-life insurance.[12] For data quality reasons, we analyse SHSS data starting from the first quarter of 2017 and retrieve information on market and notional values of securities holdings until the second quarter of 2022. Notional values refer to the nominal outstanding amount of debt securities and are unaffected by changes in market prices. Market prices and information on credit ratings in SHSS are derived from the Centralised Securities Database (CSDB). In our research we consider market and notional values of insurers' securities holdings.

For the descriptive statistics related to COVID-19 (Section 3), we aggregate security-level data at the country level and analyse transaction data. Transaction data in SHSS are either reported by national central banks or calculated otherwise. Transactions are calculated as the change of positions in nominal value, taking into account "other changes" in volume,[13] multiplied by the average price and divided by the average exchange rate. The average price is the arithmetic mean of the price value of a security at time t and t-1 (latest available price for the period), similar to the average exchange rate. This only applies to cases in which no transaction is reported. If the national central bank reports a transaction, the reported transaction is used. In our analysis, positive transaction values represent purchases and negative transaction values represent sales. Debt securities expiring in a specific quarter are negative transactions in SHSS, as they are no longer held at the end of the quarter. Transaction data are available for the main asset classes as defined by ESA (2010). In addition, we retrieve data on the bond's issuer country and credit rating.

For the regressions (Section 4), we follow Timmer (2018) and investigate changes in the nominal values of individual bond securities holdings in response to securities' returns. Furthermore, we compute lagged securities' returns as the changes in price from the start to the end of the previous quarter, plus quarterly coupon income, and divide the sum by the previous quarter's starting price. Bonds comprise long-term and short-term debt securities (hereinafter "bonds" for simplicity) which pay no or fixed annual or semi-annual coupons. For data quality reasons, we select fixed or zero-coupon bonds only. In addition, given our research question and

11 All aggregate data points for which more than 85% belong to two or fewer insurers in our study have been cleared for confidentiality by national central banks.

12 Differences in the investment behaviour of life and non-life insurers in shocks may relate to the interest rate environment (see also Duijm and Steins Bisschop (2018), Kirti and Shin (2020), and Apicella, Gallo and Guazzarotti (2021)).

13 Other changes refer to changes in data attributes between current and previous quarter such as the issuer sector, the issuer country, instrument class, and maturity date.

following Timmer (2018), our sample comprises observations with changes in holdings only.[14] Considering the few observations, the large share of pension assets[15] and the variation in the data observed in the descriptive statistics, we exclude Finnish insurers from the regressions. Our sample comprises 458,758 security-level observations from the first quarter of 2017 to the second quarter of 2022.

$$Return_{s,t-1} = \frac{Price_{s,t-1} - Price_{s,t-2} + Coupon_s}{Price_{s,t-2}} \quad (1)$$

Several aspects must be considered when analysing SHSS data, such as their incomplete coverage of holdings focusing on securities that are listed and can be easily traded only. Like many other published studies, our sample includes securities with an international securities identification number (ISIN).[16] Securities with an ISIN are typically listed and can be easily traded.[17] When comparing SHSS with SII data that include all bonds, we find that insurers' holdings of bonds without ISINs vary substantially across countries. For example, €445 billion or 50% of the total bond volume held by German insurers and €15 billion or 26% of the total bonds held by Luxembourgish insurers as of the fourth quarter of 2019 have no ISIN. In Germany, these bonds without ISINs consist of private sector as well as government bonds (the latter being issued mainly by states, municipalities, or publicly owned enterprises). Notwithstanding these coverage differences, in the regressions we analyse only those directly held securities with changes in holdings from one quarter to the next. Chart 2 compares the total asset allocation based on SII data with the relative amount of securities with changes in holdings from SHSS data as of the end of the fourth quarter of 2019. The dots show that this amount is very small in Germany, indicating very stable overall direct holdings of bonds with ISIN codes by German insurers.

14 For robustness, we also conduct regressions including securities holdings without changes and find broadly the same results.

15 See the presentation by Teija Korpiaho, FIN-FSA (ESRB Insurance Expert Group, 02.05.2022), and the Finnish Pension Alliance's (TELA) website.

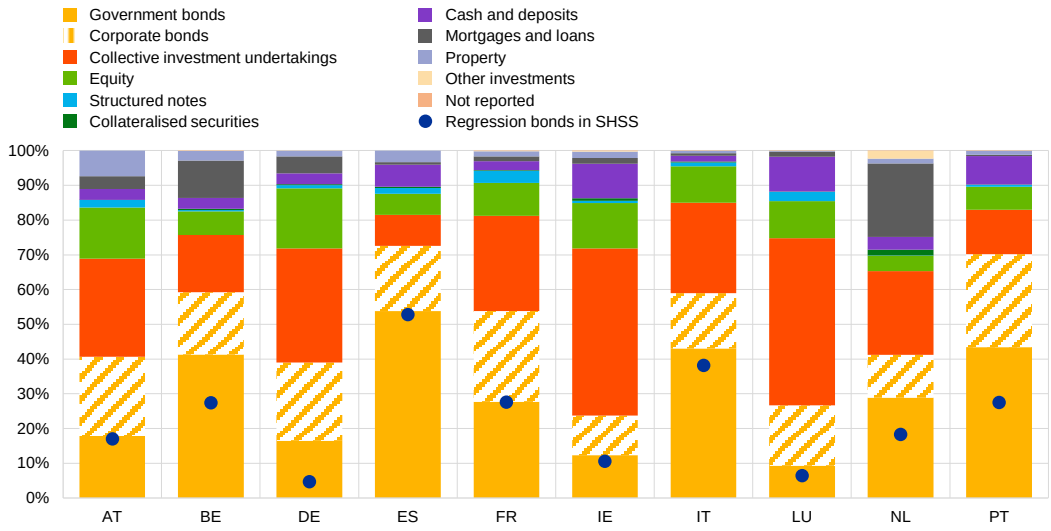
16 Less than 1% of securities holdings of government bonds in our sample have a different identifier type (e.g., CUSIP, internal code, SEDOL).

17 The relatively low frequency of quarterly data appears less relevant, as bonds often do not trade on a daily basis. MiFIR transaction reporting is daily, but insurers are exempt from it; see Art. 26 of the **MiFIR regulation (EU) 600/2014.**

Chart 2

Asset allocation and listed bonds of European insurers

(percentages, fourth quarter of 2019)



Sources: Public EIOPA insurance statistics, Solvency II reporting template S.06.02. solo quarterly; ECB SHSS; and authors' calculations.
Note: Regression bonds in SHSS refer to insurers' holdings of bonds with ISINs and changes as compared with the previous quarter.

Another difference between SHSS and SII data is the security classification and the consideration of index-linked and unit-linked insurance. Whereas SHSS refer to the ESA (2010) asset classification, SII uses a regulatory taxonomy[18] that categorises bonds guaranteed by governments as government bonds and does not distinguish between financial and non-financial sector bonds. Government bonds in SHSS are general, central, state, and local government bonds and social security funds. EIOPA (2021, 2022) conducts complementary analysis to ours, and the different samples explain the two, in both cases very small deviating descriptive statistics for the first quarter of 2020.[19] Another shortcoming is that SHSS do not account for investment fund shares held for index-linked and unit-linked insurance that reflect policyholder choices.[20] To deal with this caveat, we focus on direct bond holdings in our regression analysis.

[18] See Annex II of the **Commission Implementing Regulation (EU) 2015/2450** of 2 December 2015.

[19] Whereas EIOPA's public analysis for the first quarter of 2020 focuses on corporate bonds based on aggregated data, we focus on government bonds and on country-level data. See EIOPA (2021a), pp. 67-69 and EIOPA (2022), pp. 74-80.

[20] See also the study on the interlinkages between alternative investment funds and insurers in ESRB (2022), pp. 32-36.

3 Descriptive statistics related to COVID-19

In this section we provide an overview of insurers' investment transactions in the first quarter of 2020, when the major capital market shock occurred. The first part of the section focuses more on aggregate flows, and the second part more on country-level heterogeneity, which we analyse in the regressions in Section 4.

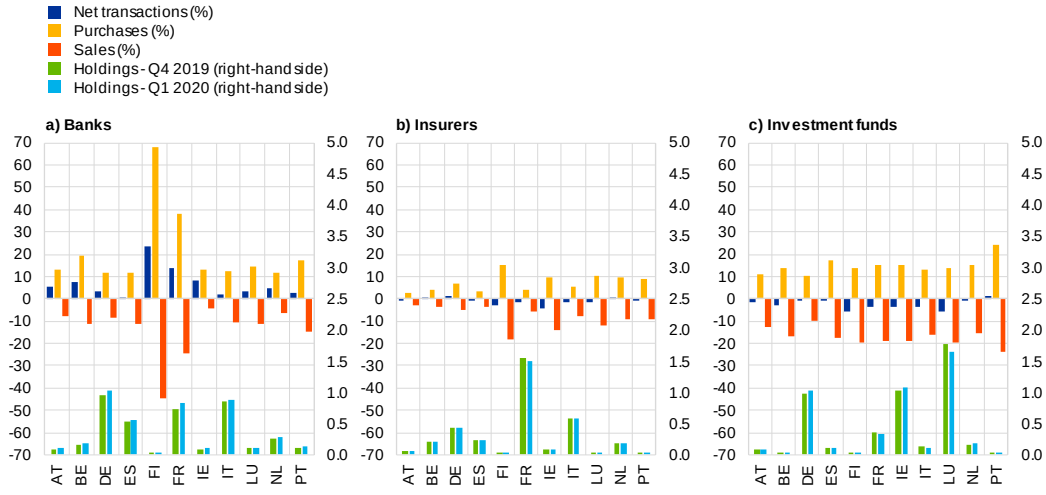
3.1 Aggregate descriptive statistics

Compared with banks and investment funds, insurers' portfolios were more stable during the shock in the first quarter of 2020. Chart 3 compares relative portfolio adjustments and absolute holdings across sectors and countries. Whereas banks increased their holdings by as much as 23% in Finland (around €8 billion) and by 14% in France (€101 billion), investment funds sold more than €190 billion bonds in response to outflows. A possible explanation for the relatively higher portfolio turnover[21] of insurers in Finland is a rumour about a taxation regulation change, causing policyholders to exit and re-enter insurance contracts.

Chart 3

Bond transactions across financial sectors

(percentages and EUR trillion, first quarter of 2020)



Sources: ECB SHSS and authors' calculations.
Note: Net transactions, purchases and sales including matured bonds are expressed as a percentage of previous period holdings at market value.

[21] Turnover is defined as the sum of purchases and sales divided by the market value at the end of the previous period. More than 50% of Finnish insurers' assets relate to statutory pension insurance; see the presentation by Teija Korpiaho, FIN-FSA (ESRB Insurance Expert Group, 02.05.2022).

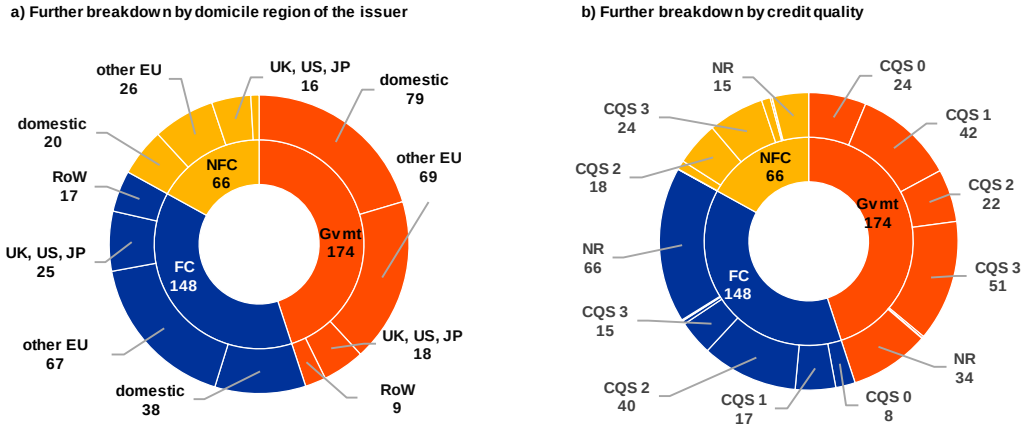
European insurers purchased and sold securities worth more than €680 billion in the first quarter of 2020. These purchases and sales (gross transactions) in bonds[22], listed equities and investment fund and MMF shares of €681 billion were 18% higher than the €579 billion in the first quarter of 2019 and 12% higher than the €610 billion in the first quarter of 2021. At the same time, purchases minus sales (net transactions) were only €55 billion, indicating portfolio rebalancing rather than strategic asset allocation changes.[23]

To understand the portfolio adjustments, we investigate insurers' bond transactions by bond market segment, issuer region and credit quality step. Government bonds accounted for 45% of gross bond transactions, followed by financial sector bonds (38%) and corporate bonds (17%). Chart 4 shows that insurers predominantly traded EU government bonds, which are liquid and often have long durations. Regarding the issuer region (Chart 4a), insurers traded mostly domestic bonds (€137 billion) and other EU bonds (€162 billion), with an almost even split between government and financial sector bonds. Regarding the bonds' credit quality (Chart 4b), insurers traded non-rated financial (€108 billion) and government bonds with the lowest investment grade rating CQS3 (€51 billion) the most.

Chart 4

Gross bond transactions of European insurers by segment

(EUR billion, first quarter of 2020)



Sources: ECB SHSS and authors' calculations.
Notes: Gross bond transactions refer to purchases and sales including matured bonds. Gvmt, FC and NFC represent bonds issued by governments (S.13), financial sector corporations (S.12) and non-financial corporations (S.11) following the ESA (2010) definition. CQS refers to credit quality step and ranges from 0 (highest, i.e. AAA) to 6 (lowest, i.e. CCC/D); "NR" represents non-rated bonds. The sample refers to insurers in Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain.

[22] Here, the term "bonds" includes debt securities with all maturities and bonds with a call option.

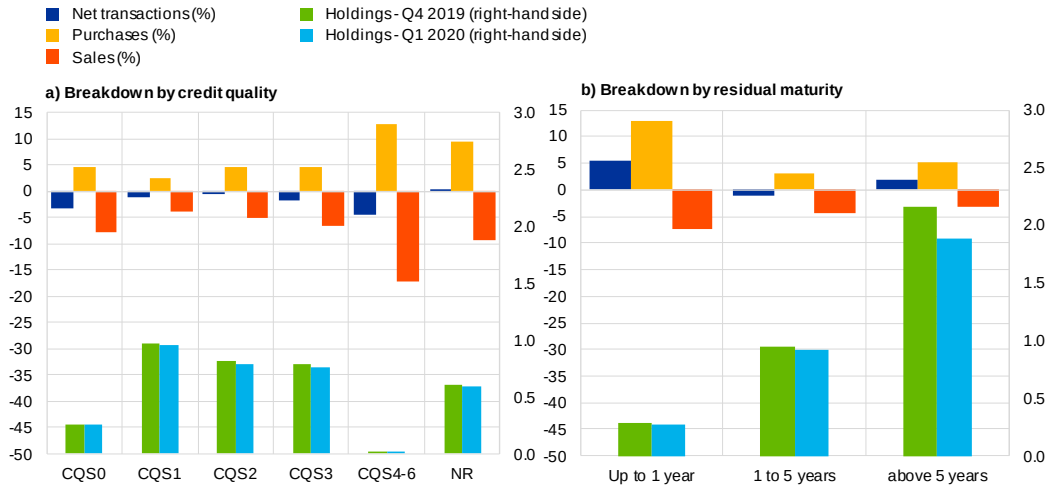
[23] The same holds for the bond allocations with gross bond transactions of €388 billion but net sales of only €38 billion.

We find insurers to be active investors, as for example they reduced bonds in all credit quality categories except those without ratings.[24] Also, insurers reduced relatively more bonds with lower credit quality (Chart 5a)[25] and net purchased short-term and long-term bonds, but net sold medium-term bonds. This indicates a barbell investment strategy (Chart 5b), which combines the advantage of faster availability of cash with higher yields from long-term bonds and is more resilient when interest rates rise or fall sharply.

Chart 5

Bond transactions of European insurers by credit quality and residual maturity

(percentages and EUR trillion, first quarter of 2020)



Sources: ECB SHSS and authors' calculations.
Notes: Net transactions, purchases and sales are expressed as a percentage of previous period holdings at market value. Sales include matured bonds. CQS refers to credit quality step and ranges from 0 (highest, i.e. AAA) to 6 (lowest, i.e. CCC/D); "NR" represents non-rated bonds. The sample refers to insurers in Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain.

Furthermore, the comparison of insurers' investment behaviour in the first quarter of 2020 with other quarters points to a pronounced shock reaction. As illustrated in Chart 6, the second quarter of 2020 marked a reversal in the investment behaviour of insurers in France, Germany, Italy, and Spain compared with the first quarter of 2020. German insurers net purchased corporate bonds, but net sold financial sector bonds, mostly in the lowest investment grade category (€1.3 billion) and with high yields (€208 million). Overall, bond transaction volumes in the second quarter of 2020 were lower than in the first quarter of 2020 (€651 billion versus €681 billion). When comparing the first quarter of 2020 with the first quarter of 2019 and the first quarter of 2021 to account for seasonality in insurance premia, the changes are confirmed. For example, insurers in France net purchased government bonds in the first quarter of 2019 and the first quarter 2021 and net purchased financial sector bonds in the first quarter of 2019. Insurers in Ireland net

[24] Art. 176a (4) of Commission Delegated Regulation (EU) 2015/35 provides for a credit risk capital charge for bonds without ratings, which is mostly comparable to the lowest investment grade rating (CQS3).

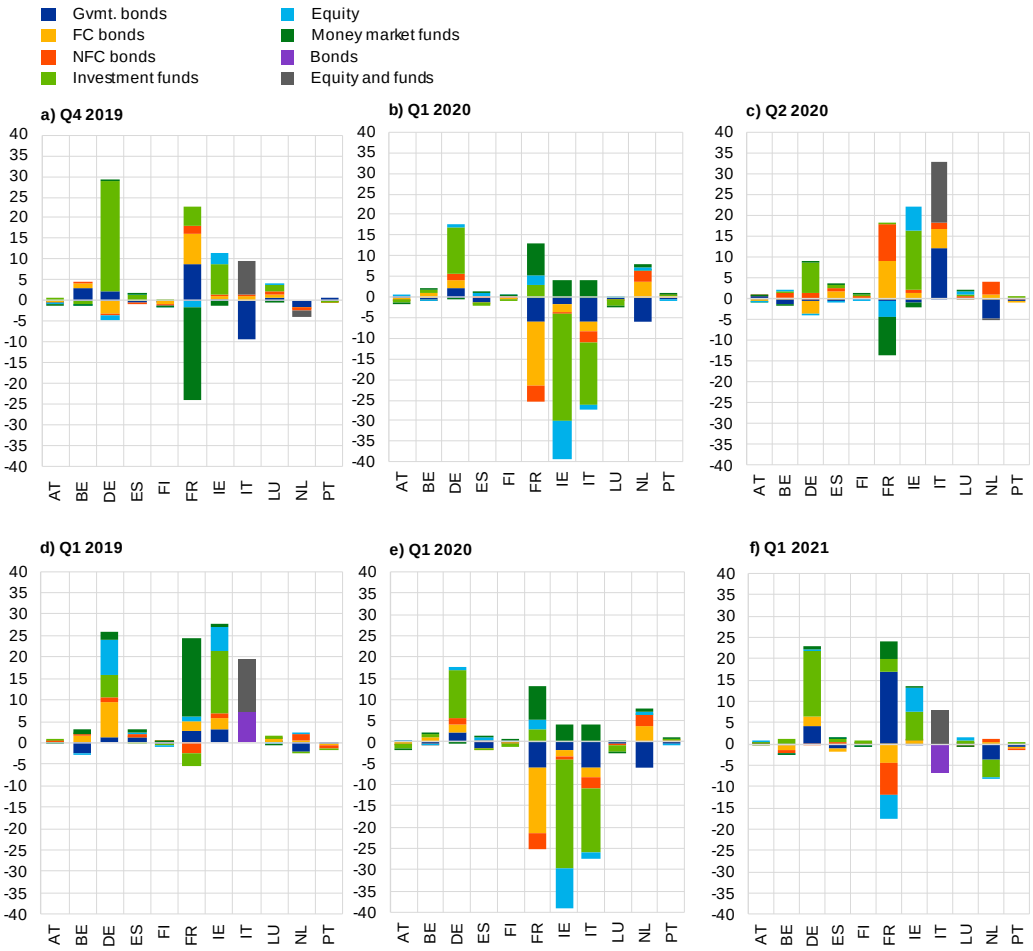
[25] In line with this, analysis with SII data suggests that insurers were net sellers of bonds with the lowest investment grade credit quality CQS3 in the first quarter of 2020 (EIOPA, 2021a, p. 67).

purchased investment funds in the first quarter of 2019 and the first quarter of 2021, while those in Spain net purchased government and financial sector bonds. The next subsection and the empirical part (Section 4) will shed more light on the country-level heterogeneity in insurers' investments.

Chart 6

Net transactions of European insurers in the first quarter of 2020 compared with other quarters

(EUR billion)



Sources: ECB SHSS and authors' calculations.
Notes: For confidentiality reasons and for other quarters than the first quarter of 2020, information is aggregated for Italy ("equity and funds"), money market funds are not disclosed for the Netherlands and Portugal, and equity is not disclosed for Portugal. Gvmt., FC and NFC bonds represent bonds issued by governments (S.13), financial sector corporations (S.12) and non-financial corporations (S.11) following the ESA (2010) definition. Net transactions are purchases minus sales including matured bonds as a percentage of previous period holdings at market value.

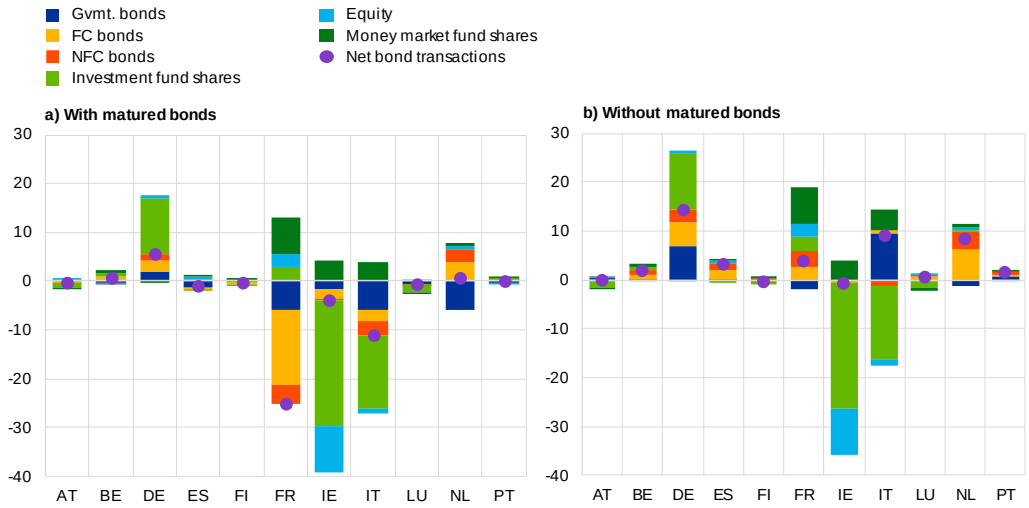
3.2 Country-level descriptive statistics

One difference across national insurers is their liquidity buffers from matured bonds. Whereas European insurers typically invest more than two-thirds of their assets in bonds, the literature (e.g., Apicella, Gallo and Guazzarotti, 2022) broadly implicitly or explicitly excludes matured bonds in its analysis. This is typically the most appropriate approach, as matured bonds are not the result of active investment decisions. Given our focus in the descriptive statistics on showing the changes in the composition of insurers' asset portfolios during the COVID-19 shock, we include matured bonds in sell decisions and conduct robustness tests excluding matured bonds from net transactions.[26] The comparison of the two approaches shows possible liquidity buffers. Chart 7 illustrates how insurers in some Member States may have increased their liquid assets by not reinvesting returned principal from matured bonds in the first quarter of 2020. Possible explanations for these newly built cash reserves may be the differences in asset compositions across countries illustrated in Chart 2 or the rise in net claims and expenses (ESRB, 2021).[27] Without matured bonds, insurers in France, Italy, Luxembourg, Portugal and Spain, were net bond buyers, pointing to countercyclical investment behaviour in the shock period.[28]

Chart 7

Net transactions of European insurers with and without matured bonds

(EUR billion, first quarter of 2020)



Sources: ECB SHSS and authors' calculations.
Notes: Net transactions are purchases minus sales including matured bonds (panel a) and excluding matured bonds (panel b). Gvmt., FC and NFC bonds represent bonds issued by governments (S.13), financial sector corporations (S.12) and non-financial corporations (S.11) following the ESA (2010) definition.

[26] We find that, on average, 2% of insurers' bond holdings matured in the first quarter of 2020.

[27] See Chart 4.3.C in ESRB (2021), p.113. On average, 2-3% of EEA insurers' bond holdings mature each quarter; see EIOPA (2020c), p. 16. Unless otherwise stated, sales include matured bonds in our analysis.

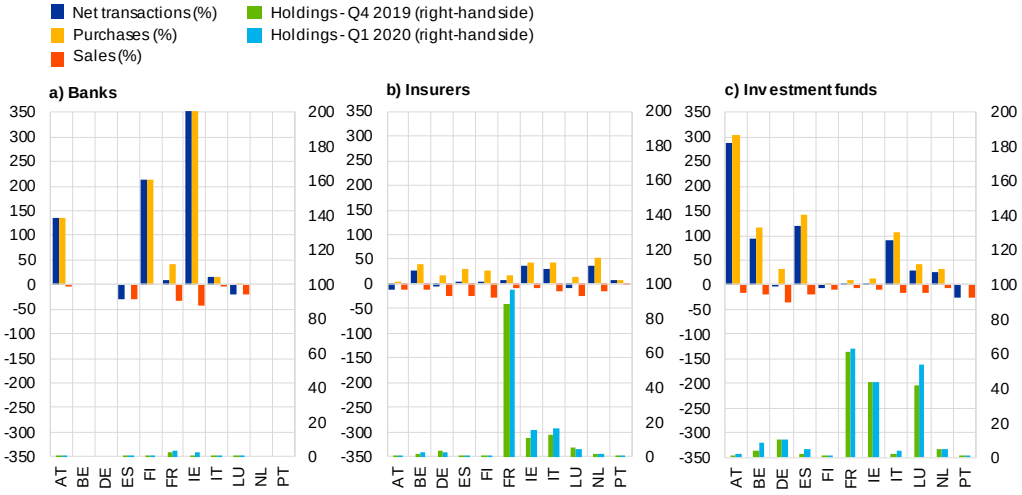
[28] German insurers also net purchased more bonds in the first quarter of 2020 when considering matured bonds. French insurers have the largest direct bond holdings in Europe of approximately €1.5 trillion as of the fourth quarter of 2019.

Another difference across national insurers is their use of MMFs for liquidity management. By selling MMF shares, insurers generate liquidity; by purchasing them they invest liquidity from disposed assets.[29] With a volume of €16 billion, insurers were the second largest MMF net buyers among financial sectors in Europe in the first quarter of 2020.[30] Insurers in France (€7 billion), Ireland (€4 billion) and Italy (€4 billion) were the largest MMF net buyers (Chart 8), whereas insurers in Belgium increased MMFs by more than 30% despite small volumes. As for all analysis with country-level data, this does not preclude that an individual insurer behaved differently and that there might have been redemptions at the beginning and subscriptions at the end of the quarter. In addition to the diversified counterparty risk and the small return offered by non-public debt EU MMFs (ESRB, 2021), the trend towards MMF investments may also reflect low deposit rates.

Chart 8

MMF share transactions across financial sectors

(percentages and EUR billion, first quarter of 2020)



Sources: ECB SHSS and authors' calculations.
Notes: Net transactions, purchases and sales are expressed as a percentage of previous period holdings at market value. Data from Dutch and German banks are excluded for confidentiality reasons. For comparison, y-axis scales are the same for all sectors. For Irish banks the value is 1,079% for net transactions and 1,123% for purchases.

A third difference across national insurers is their trading intensity. We measure trading intensity by comparing the total transaction share across all asset classes with market shares of insurers in our sample countries. The points referring to the y-axis in Chart 9 depict the transaction-to-market-share ratio in the first quarter of 2020. They show that among others, insurers in countries with large index-linked and unit-linked insurance markets tend to trade relatively more, and an explanation for this is that these products can typically be redeemed by policyholders

29 See also Fache Rousová, Ghio, Kördel and Salakhova (2020).

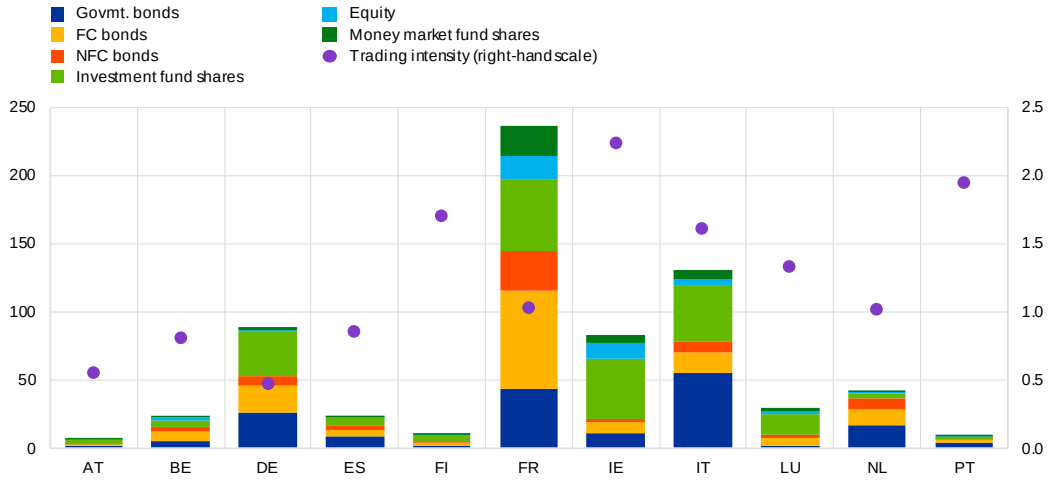
30 Investment funds net purchased money market fund shares worth €25 billion in the first quarter of 2020.

without penalty.[31] For robustness, we therefore exclude investment fund shares from transactions and index-linked and unit-linked insurance from market shares. Despite this adjustment, our findings that insurers in Ireland, Portugal and Italy traded the most are confirmed.

Chart 9

Gross transactions and trading intensity of European insurers

(EUR billion, transaction-to-market-share ratios, first quarter of 2020)



Sources: ECB SHSS; EIOPA insurance statistics, template S.06.02. solo quarterly; and authors' calculations.
Notes: Gross transactions are the sum of purchases and sales including matured bonds. Gvmt., FC and NFC bonds represent bonds issued by governments (S.13), financial sector corporations (S.12) and non-financial corporations (S.11) following the ESA (2010) definition. Trading intensity is the total gross transaction share of insurers in a country divided by their market share measured by total assets. Total assets from EIOPA insurance statistics are as of the fourth quarter of 2019.

Additional descriptive statistics on insurers' investment transactions in the first quarter of 2020 are in the annex. These charts show analyses referring to other bond characteristics such as issuer region (Chart A1), issuer sector (Chart A2), residual maturity (Chart A3) and credit rating (Chart A4). We see a clear trend that insurers in almost all countries purchased very short-term and long-term debt with less than one and more than five years' residual maturity, while net selling bonds with medium-term residual maturities. This confirms the barbell investment strategies observed at the aggregate level in Section 3.1.

[31] In the fourth quarter of 2019, the share of index-linked and unit-linked products was 14% of total insurance assets in Austria, 13% in Belgium, 54% in Finland, 14% in France, 5% in Germany, 69% in Ireland, 19% in Italy, 68% in Luxembourg, 18% in the Netherlands, 24% in Portugal, and 7% in Spain; see **EIOPA Insurance Statistics Asset Exposures** template S.06.02. solo quarterly. Insurers in the larger index-linked and unit-linked markets net sold investment funds in the first quarter of 2020.

4 Regressions

Having shown insurers' shock reaction and country-level heterogeneity in investment behaviour in the descriptive statistics in Section 3, we next investigate insurers' role as stabilisers of financial markets over a longer time horizon. To this end, we focus on debt securities holdings and replicate Timmer's (2018) study on cyclical investment behaviour. The sample for the regression analysis and its coverage of SII data is set out in Section 2 and Chart 2.

4.1 Summary statistics

To make our study comparable to Timmer (2018), we use the same summary statistics. As shown in Table 1, European insurers on average hold individual debt securities worth €68.4 million (Table 1a) and individual government debt securities worth €118.5 million (Table 1b). Insurers' median bond holdings of €4.2 million and median government bond holdings of €7.0 million are a lot smaller, reflecting the country-level differences illustrated in Table 2.

Despite insurers' preference for government bond investments, there is wide variation in the average value of individual government bond holdings, ranging from €6.0 million in Luxembourg to €331.5 million in France. For insurers in Europe's second-largest insurance market, Germany, we find average government bond holdings of €49.3 million. The highest number of buy-and-sell observations are in France, and the lowest are in Portugal (Table 2). In line with their larger individual holdings, insurers' government bond transactions in Italy and France exceed those in other countries. Relevant for our investment behaviour study, the percentage changes in holdings are the largest in the Netherlands and Germany, although the securities with ISINs and quarterly changes in holdings included in our sample represent only a small portion of German insurers' total bond assets (Chart 2). While insurers increase (decrease) their holdings by 12.5% (14.2%) on average (Table 1b), Dutch insurers increase (decrease) their holdings by 21.2% (24.6%) on average and German insurers by 16.8% (20.3%) on average (Table 2). By contrast, the changes in holdings are the smallest in Austria and Spain, with average increases and decreases of less than 7%.

The standard deviation of the *NetBuy* variable suggests that for bonds with changes in holdings, German insurers transact relatively larger amounts on average than insurers in other countries. The standard deviation for changes in nominal government bond holdings *NetBuy* is 43.2% on average (Table 1b) and 50.1% for German insurers, compared with 17.0% for Austrian and 20.1% for Spanish insurers (Table 2). Given the higher *NetBuy* standard deviation of 67% for German insurers in Timmer (2018), their stable direct bond holdings (Chart 2) and the small absolute values of holdings with changes (median of €7.4 million in Germany versus €43.6 million in France; see Table 2), an explanation may be low levels of trading coupled with large and stable core bond portfolios.

Reflecting the low interest rates in the sample period, the average return for government bonds across holder countries is only 0.2%, with a standard deviation of 5.1% and small variations across countries.[32] The highest average return of 0.5% with the highest standard deviation of 7.7% is earned by insurers in Belgium.

Table 1

Summary statistics of European insurers' bond holdings

(EUR million and percentages, first quarter of 2017 to second quarter of 2022)

All bonds (Gvmt., FC, NFC bonds)							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	68.38	2.96	3.24	-0.005	0.117	0.132	0.004
Median	4.20	0.06	0.08	0.000	0.018	0.020	0.002
Std	460.27	23.71	23.80	0.406	0.371	0.402	0.058
Observations	458,758	234,166	223,592	458,758	234,166	224,592	458,758
Gvmt. bonds							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	118.47	5.17	5.75	-0.002	0.125	0.142	0.002
Median	7.01	0.10	0.12	0.000	0.019	0.021	0.001
Std	671.24	33.63	31.79	0.432	0.391	0.432	0.051
Observations	208,584	109,355	99,229	208,584	109,355	99,229	208,584

Sources: ECB SHSS and authors' calculations.
Notes: All bonds represent bonds issued by governments (S.13), financial sector corporations (S.12) and non-financial corporations (S.11) following the ESA (2010) definition. "Std" refers to the standard deviation. "Holdings" is the nominal value of government bonds held by insurers. "Buy" and "Sell" refer to the amount bought and sold in EUR million. "NetBuy" is the change in the log of the nominal amount held. "Buy%" and "Sell%" are the changes in the log of the nominal amount held if positive or negative, respectively. "Return" is the holding period return defined as the quarterly change in the price plus the quarterly coupon divided by the price in the previous quarter. The sample refers to insurers in Austria, Belgium, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain.

[32] Reflecting the higher credit risk, Table 1 suggests that the average return for the sample including government, FC and NFC bonds is higher at 0.4% and has a higher standard deviation of 5.8%.

Table 2

Summary statistics of European insurers' government bond holdings by country

(EUR million and percentages, first quarter of 2017 to second quarter of 2022)

AT							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	26.48	0.55	1.31	-0.010	0.024	0.057	0.000
Median	10.67	0.07	0.12	0.000	0.007	0.013	0.000
Std	42.41	2.93	4.07	0.17	0.121	0.214	0.044
Observations	12,520	7,805	4,715	12,520	7,805	4,715	12,520
BE							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	92.53	3.23	2.58	-0.011	0.153	0.180	0.005
Median	0.68	0.03	0.05	0.000	0.037	0.049	0.004
Std	494.35	21.58	12.35	0.452	0.406	0.434	0.077
Observations	14,405	7,338	7,067	14,405	7,338	7,067	14,405
DE							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	49.29	6.28	7.55	-0.002	0.168	0.203	0.004
Median	7.37	0.18	0.40	0.005	0.032	0.039	0.005
Std	140.97	29.30	22.64	0.401	0.450	0.483	0.043
Observations	31,014	16,848	14,166	31,014	16,848	14,166	31,014
ES							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	146.72	4.30	3.94	0.008	0.063	0.053	0.002
Median	13.40	0.09	0.07	0.000	0.005	0.004	0.001
Std	602.06	21.43	20.62	0.209	0.212	0.188	0.043
Observations	17,680	9,338	8,342	17,680	9,338	8,342	17,680
FR							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	331.50	10.20	10.21	0.003	0.086	0.080	0.002
Median	43.60	0.22	0.22	0.000	0.008	0.008	0.001
Std	1371,64	56.53	53.76	0.350	0.337	0.336	0.050
Observations	31,182	15,629	15,553	31,182	15,629	15,553	31,182

IE							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	18.98	2.49	2.37	0.000	0.150	0.160	0.002
Median	4.33	0.07	0.10	0.000	0.024	0.025	0.001
Std	37.11	11.20	7.79	0.479	0.435	0.470	0.044
Observations	29,981	15,479	14,502	29,981	15,479	14,502	29,981
IT							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	258.74	10.51	12.27	0.006	0.113	0.127	0.001
Median	17.02	0.22	0.35	0.002	0.013	0.020	0.001
Std	910.93	57.07	54.77	0.439	0.361	0.490	0.056
Observations	24,785	13,792	10,993	24,785	13,792	10,993	24,785
LU							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	6.00	0.64	0.40	-0.002	0.158	0.164	0.003
Median	1.23	0.02	0.02	0.000	0.021	0.021	0.002
Std	14.38	2.5	2.01	0.482	0.439	0.470	0.056
Observations	25,521	12,852	12,669	25,521	12,852	12,669	25,521
NL							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	95.83	5.37	8.75	-0.039	0.212	0.246	0.003
Median	3.89	0.20	0.40	-0.007	0.040	0.043	0.002
Std	300.92	19.67	29.98	0.453	0.503	0.510	0.036
Observations	12,126	5,470	6,656	12,126	5,470	12,126	12,126
PT							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	30.96	2.65	3.23	-0.007	0.111	0.131	0.000
Median	3.65	0.02	0.03	0.000	0.006	0.011	0.000
Std	131.13	14.95	20.31	0.453	0.437	0.436	0.036
Observations	9,370	4,804	4,566	9,370	4,804	4,566	9,370

Sources: ECB SHSS and authors' calculations.
Notes: Bonds represent bonds issued by governments (S.13) following the ESA (2010) definition. "Std" refers to the standard deviation. "Holdings" is the nominal value of government bonds held by insurers. "Buy" and "Sell" refer to the amount bought and sold in EUR million. "Net Buy" is the change in the log of the nominal amount held. "Buy%" and "Sell%" are the changes in the log of the nominal amount held if positive or negative, respectively. "Return" is the holding period return defined as the quarterly change in the price plus the quarterly coupon divided by the price in the previous quarter.

Chart 10 illustrates the average changes in nominal government bond holdings from one quarter to the next. Higher mean changes in holdings of up to 25% for German, Dutch and Belgian insurers point to more active investment strategies.[33] At the onset of the COVID-19 pandemic in the first quarter of 2020, the drop in mean changes in Ireland and the Netherlands indicates net selling. Meanwhile, the rising interest rate environment since 2022 appears to be associated with government bond net purchases in five countries (Belgium, Ireland, Italy,

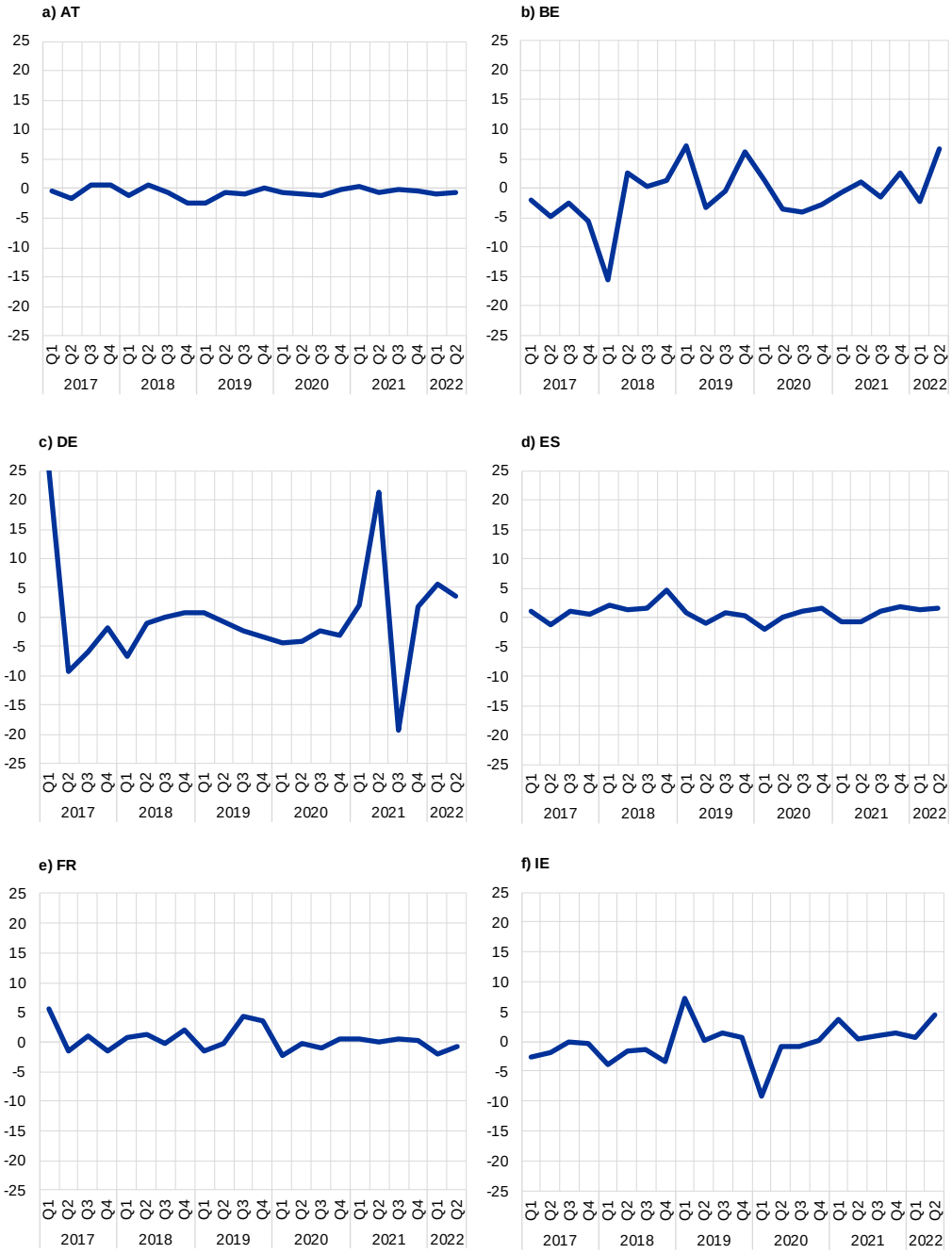
[33] The portion of bonds with holding changes and ISINs for German insurers, however, is small and approximately 12% of their direct bond holdings as of the fourth quarter of 2019 (Chart 2).

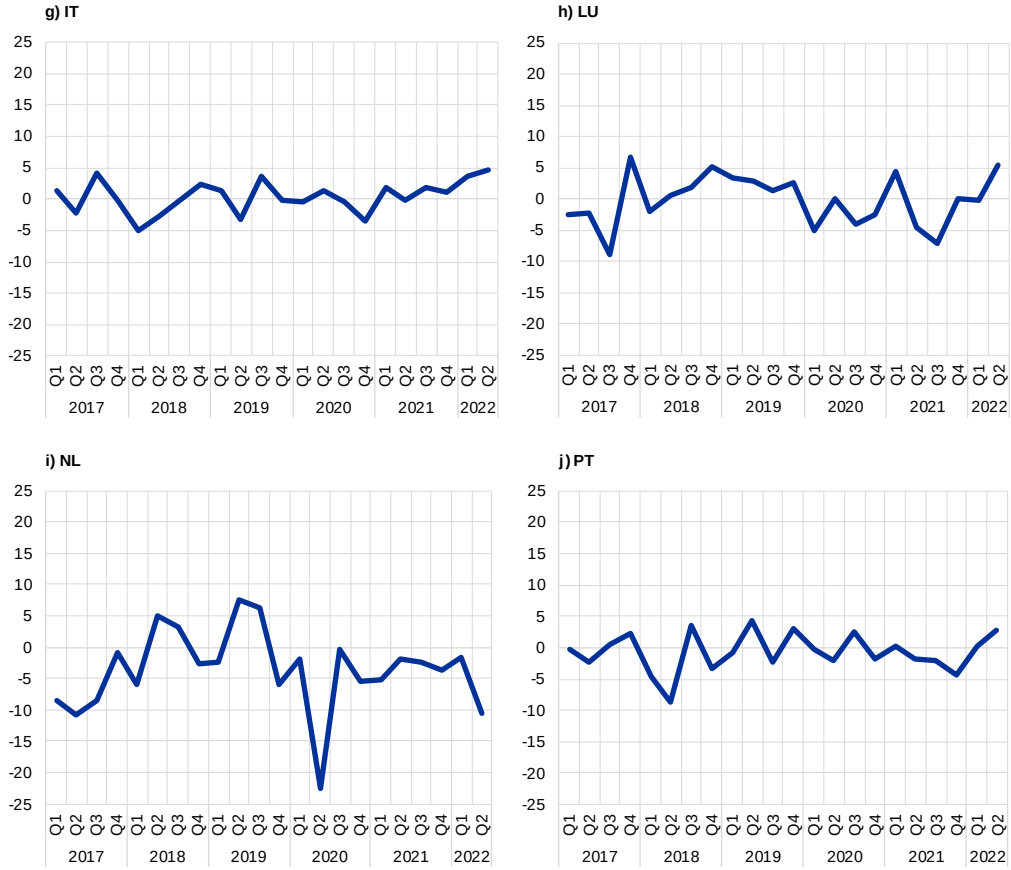
Luxembourg, and Portugal), confirming the findings of Fache Rousová and Giuzio (2019b) as regards insurers' investment behaviour in response to risk-free rates. This trend is confirmed in the aggregate changes in bond holdings in Chart A6 in the annex.

Chart 10

Mean changes in nominal government bond holdings of European insurers by country

(percentages of previous period holdings, first quarter of 2017 to second quarter of 2022)





Sources: ECB SHSS and authors' calculations.
Notes: Government bonds are as defined by ESA (2010). Changes are the change in the log of the nominal amount held. AT: n=12,520; BE: n=14,405; DE: n=31,014; ES: n=17,680; FR: n=31,182; IE: n=29,981; IT: n=24,785; LU: n=25,521; NL: n=12,126; PT: n=9,370.

4.2 Main results

We attempt to shed light on the question of whether insurers under SII act as stabilisers of financial markets and whether their investment behaviour differs across countries. Our regressions are in the spirit of Timmer (2018), and we investigate how investment decisions relate to past securities returns. The lack of information about the timing of transactions and returns within a quarter impedes the assessment of cyclical investment behaviour. To rule out the possibility that transactions are executed before returns are observed and that these returns reflect the price impact of insurers' transactions, we regress changes in nominal holdings on the lagged securities' returns.

Instead of comparing insurers with other financial sectors we compare insurers across European countries. To this end, we estimate FE panel data models with two autoregressive lags.[34] Whereas Timmer (2018) defines dummy variables for sectors, we estimate an interaction term of insurers' country of incorporation ("holder country", *hc*) and the lagged return of individual debt securities *s* held by insurers in a country $Return_{s,hc,t-1}$. Austria is thereby our base case, and the investment behaviour of Austrian insurers is captured by the return coefficient. More precisely, we regress the percentage change in the nominal amount held by insurers in a country $NetBuy_{s,hc,t}$ on the interaction of the holder country *hc* and the lagged security return $Return_{s,hc,t-1}$ by estimating the following model:

$$NetBuy_{s,hc,t} = \beta_1 Return_{s,hc,t-1} + \beta_2 Return_{s,hc,t-1} * hc_t + \alpha_{s,t} + \alpha_{hc,t} + \epsilon_{s,hc,t} \quad (2)$$

While the dependent variable *NetBuy* is the change in log nominal holdings, $Return_{t-1}$ refers to the lagged security return (see also Section 2). We control for different combinations of security and holder country FE, $\alpha_{s,t}$ and $\alpha_{hc,t}$, which can be constant or time-variant and affect insurers' investment behaviour through rating downgrades or the size and investment strategy of insurers in a country, for example. To investigate home bias, we also conduct separate regressions for a sub-sample of domestic securities, which we define as securities with the same issuer and holder country.

As illustrated in equation (3) and with a dummy variable for the first and second quarters of 2020, we investigate insurers' reaction to the COVID-19 shock in the regressions. Accordingly, we estimate a triple interaction term $COVID * Return_{s,hc,t-1} * hc_t$ to investigate whether insurers in a country exhibit procyclical or countercyclical investment behaviour in the shock.

$$NetBuy_{s,hc,t} = \beta_1 Return_{s,hc,t-1} + \beta_2 COVID * Return_{s,hc,t-1} * hc_t + \alpha_{s,t} + \alpha_{hc,t} + \epsilon_{s,hc,t} \quad (3)$$

To account for the stable characteristics of European insurance markets, we test FE models. To consistently estimate regressions, variation in the explanatory variables is needed. The characteristics of the national European insurance markets, however, are relatively stable. For example, the share of index-linked and unit-linked insurance is higher than 70% of total insurance assets in Ireland and Luxembourg, but this changes by less than 1% in 95% of all observations. As separate country-level control variables can therefore lead to over-specified models, we choose a parsimonious regression approach with an FE model. To capture the differences across countries and given our specific research question about cyclical investment behaviour across European countries, our unit of observation are individual securities held by insurers in a holder country. Different from ordinary least squares (OLS) regressions, FE panel data models control for time-invariant characteristics as they consider deviations from the mean for individual units only. Models capturing variation within rather than between holder countries over time appear better suited to this analysis, and OLS models can therefore be considered inferior. Without information on individual insurers, however, no further insights on country-level heterogeneity can be provided, as all explanatory variables, for example solvency ratios, are captured by the country-level FE. Following Timmer (2018), our focus is therefore on variation at the security level.

[34] The Durbin-Watson test statistics show that insurers' transactions tend to be autocorrelated; for simplicity the two lags of the dependent variable included as explanatory variables are not shown in the regression equations.

As buying (selling) securities whose price has risen (fallen) is associated with procyclical investment behaviour, we interpret positive coefficients as a signal of procyclical behaviour and negative coefficients as a signal of countercyclical behaviour. The regression results refer to changes in holdings in response to changes in returns. To ensure the results' robustness and for each model equation (2) and (3), we estimate several specifications controlling for different combinations of FE. In column (1) in the regression tables we consider constant security FE, in column (2) constant security and time FE, in column (3) time-variant holder country FE, in column (4) constant security and time-variant holder country FE, and in column (5) constant and time-variant security and holder country FE. Column (6) replicates column (4) with log returns to account for non-normal return distributions.[35] Constant holder country FE are considered in all models when estimating interaction effects with countries. Time FE account for events which are market-wide. Security FE are characteristics such as the bond's credit rating, maturity, or coupon. Holder country FE are characteristics which may relate to the size of insurers' investments, to national investment strategies or to national investment regulations, for example. While these characteristics are typically constant, certain events such as natural catastrophes may affect certain countries at a specific moment in time. Our idea is to control in different model specifications for an increasing number of factors which can affect insurers' investment behaviour. Security returns may be interpreted as time-variant security characteristics, which is why the level of returns cannot be identified in the estimations with time-variant security FE in column (5).[36] The coefficient on the interaction term in column (5) therefore shows how much more procyclical or countercyclical insurers in a country invest in comparison with insurers in the base country of Austria. Given our unit of observation, individual securities held by insurers in a country, preferences for certain securities by insurers in a country are also captured by the FE model. To account for the fact that transactions by insurers in a country can be correlated over time, we use clustered standard errors at the security and holder country level.

Tables 3 and 4 show that insurers in the Netherlands invest countercyclically overall, as the negative coefficients indicate a decrease in holdings when past returns are positive. Column (5) in Table 3 indicates that a return of 10% in the last quarter is associated with a 4.1 percentage point larger decrease in nominal holdings compared with Austrian insurers. This countercyclical behaviour is confirmed in all model specifications and is more pronounced for government bonds (Table 4), which account for 28.9% of Dutch insurers' investments.[37] Differences between our results for the Netherlands and those of Duijm and Steins Bisschop (2018) can be explained by a different pre-SII sample and by a different method, as the authors assess return differentials between equities and bonds. We further find countercyclical investment behaviour for the Netherlands' neighbouring country of Belgium. Column (5) in Table 4 indicates that a return of 10% in the last quarter is associated with a 3.0 percentage point larger decrease in nominal government bond holdings compared with Austrian insurers. This behaviour is confirmed when including corporate bonds in the sample, as shown in column (2) in Table 3 (see also Table 8 in Section 4.3 for a focus on non-financial corporate bonds).

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35 Harvey and Siddique (2000) show that asset returns are non-normal as they have systematic skewness. See also Kraus and Litzenberger (1976).

36 To account for time-variant security FE, insurers in at least two countries must trade the same security in a quarter (see also Timmer, 2018).

37 See **EIOPA Insurance Statistics**, Solvency II reporting template S.06.02. solo quarterly, fourth quarter of 2019.

Table 3

Heterogeneity in cyclical investment behaviour – interactions (all bonds)

	Dependent Variable: *NetBuy*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Base	Base	Base	Base	Base	Log returns
Return	0.0231	0.0308	0.0478	0.0107		-0.0099
	(0.035)	(0.037)	(0.036)	(0.044)		(0.031)
Return*BE	-0.1328***	-0.1235**	-0.0779	-0.0537	-0.0649	-0.0345
	(0.048)	(0.048)	(0.049)	(0.057)	(0.155)	(0.044)
Return*DE	-0.2569***	-0.2243***	0.1428**	0.1928***	0.3913**	0.1438**
	(0.056)	(0.063)	(0.060)	(0.074)	(0.165)	(0.063)
Return*ES	0.1253	0.1182	0.1416	0.1489	0.0884	0.2673**
	(0.087)	(0.087)	(0.105)	(0.110)	(0.137)	(0.124)
Return*FR	0.1030**	0.1053**	0.0189	0.0792	0.1163	0.0800**
	(0.068)	(0.045)	(0.046)	(0.054)	(0.136)	(0.042)
Return*IE	-0.0149	0.000	-0.0329	0.0187	0.2178	-0.2591
	(0.117)	(0.115)	(0.112)	(0.130)	(0.145)	(0.158)
Return*IT	0.0857	0.1019*	0.1244	0.1845**	0.2973**	0.2584***
	(0.061)	(0.060)	(0.075)	(0.074)	(0.148)	(0.073)
Return*LU	0.0738	0.0795	0.0455	0.1034	0.0426	0.0989*
	(0.061)	(0.061)	(0.063)	(0.069)	(0.143)	(0.053)
Return*NL	-0.1410**	-0.1233*	-0.4011***	-0.3916***	-0.4108***	-0.3039***
	(0.066)	(0.065)	(0.075)	(0.081)	(0.163)	(0.065)
Return*PT	-0.1010	-0.1038	-0.1921*	-0.1923*	-0.1949	-0.1318
	(0.088)	(0.088)	(0.099)	(0.109)	(0.172)	(0.112)
Security FE	Yes	Yes	No	Yes	-	Yes
Time FE	No	Yes	-	-	-	-
Sec.*Time FE	No	No	No	No	Yes	No
HC*Time FE	No	No	Yes	Yes	Yes	Yes
R^2	0.0748	0.0764	0.0163	0.0820	0.3114	0.0834
Observations	340,407	340,407	342,249	340,407	254,456	340,407

Sources: ECB SHSS and authors' calculations.
Notes: Standard errors are in parentheses ($p < 0.1$, ** $p < 0.05$, *** $p < 0.01$). Securities are bonds as defined by ESA (2010) (government sector code starting with S.13, financial sector code with S.12 and non-financial sector code with S.11). "Net Buy" is the change in the log of the nominal amount of security s held at the end of the quarter t by insurers in holder country hc. "Return" is the quarterly change in the price plus the coupon divided by the price of the security in the past quarter. The regression includes control variables for security s interacted with time t and for holder country hc interacted with time t. To account for heteroscedasticity and autocorrelation of the residuals, two lagged terms of the dependent variable are included as regressors, and standard errors are clustered at the security and holder country level. The estimations are FE panel data models spanning security, holder country and time FE. Significant FE are indicated by "Yes".*

The specific pattern in German insurers' net transactions in Chart 10 shows why controls for time-varying country FE are important in cross-country studies. FE models control for unobserved variables, i.e. specific events in a country and period, by demeaning the dependent variables, in our case net transactions. Through this demeaning only differences between net transactions and their averages for a country and period are analysed. When these averages change, controls for time-varying country FE can lead to different assessments as shown in columns (1), (2) and (3) to (6) for Germany in Table 3. As the net transactions in Chart 10 do not reflect data errors and their volatility is lower than in Timmer (2018), we do not winsorise them.[38] While controlling for time FE may lead to some over-controlling, the coefficient in column (2) for Germany in the single country estimations in Table 5 can be interpreted as a robustness test. When comparing our estimations with Timmer (2018) and following the author's definition of cyclicality, we find that German insurers invest less countercyclically. We find them to increase their bond holdings by 1.9 percentage points after a 10% return in the last quarter in Table 3 column (4), whereas Timmer (2018) finds that they decrease their bond holdings by 6.7 percentage points in their pre-SII sample.[39]

In specific countries and situations, insurers invest procyclically by selling securities following periods of negative returns. By considering country FE (Tables 3 and 4) and conducting separate regressions for each holder country (Table 5), we find that Italian insurers invest procyclically overall and that this trend is stronger for government bonds. To a lesser extent, we note the same trend for French insurers.[40] The opposite behaviour, however, is observed in Italy for domestic government bonds, which account for more than 70% of Italian insurers' government bond holdings (Chart 1b). Following column (3) in Table A4 in the annex, Italian insurers increase their domestic government bond holdings by 3.7 percentage points following a 10% decline in returns in the last quarter. This confirms the findings of Apicella, Gallo and Guazarotti (2022) that Italian insurers' investment strategies are stabilising overall.

[38] Possible explanations for larger relative net transactions are transfers to and from funds or partial order executions due to lower liquidity. German insurers invest approximately a third of their total assets via investment funds (see public EIOPA insurance statistics).

[39] These results refer to column (1) in Table 2 in Timmer (2018).

[40] Chart A5 shows that Italian and French insurers are among the largest European direct government bond holders.

Table 4

Heterogeneity in cyclical investment behaviour – interactions (government bonds)

	Dependent Variable: *NetBuy*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Base	Base	Base	Base	Base	Log returns
Return	0.1187***	0.1354***	0.0978	0.0931**		0.0252
	(0.032)	(0.038)	(0.060)	(0.046)		(0.023)
Return*BE	-0.2068***	-0.2114***	-0.1443**	-0.1429**	-0.3048**	-0.0800**
	(0.044)	(0.048)	(0.070)	(0.058)	(0.148)	(0.038)
Return*DE	-0.4470***	-0.3958***	0.1591*	0.1224	0.3451**	0.1513**
	(0.055)	(0.055)	(0.086)	(0.077)	(0.172)	(0.060)
Return*ES	-0.0146	-0.0249	-0.0350	-0.0433	0.0550	0.0440
	(0.046)	(0.048)	(0.071)	(0.062)	(0.126)	(0.050)
Return*FR	0.1642**	0.1632***	0.0562	0.0951	0.1907	0.1850***
	(0.055)	(0.055)	(0.084)	(0.070)	(0.122)	(0.059)
Return*IE	0.0406	0.0585	0.0536	0.0505	0.1022	0.0723
	(0.084)	(0.083)	(0.107)	(0.108)	(0.133)	(0.079)
Return*IT	-0.0097	0.0083	0.0853	0.1715**	0.3207***	0.2806***
	(0.062)	(0.062)	(0.099)	(0.082)	(0.118)	(0.085)
Return*LU	-0.1342	-0.1346	-0.1289	-0.1024	-0.2326	0.0042
	(0.090)	(0.090)	(0.107)	(0.101)	(0.144)	(0.087)
Return*NL	-0.2001***	-0.1882***	-0.4207***	-0.4468***	-0.5401***	-0.3201***
	(0.069)	(0.071)	(0.094)	(0.087)	(0.153)	(0.066)
Return*PT	-0.1376	-0.1428	-0.1555	-0.2022	-0.1425	-0.1175
	(0.121)	(0.121)	(0.183)	(0.182)	(0.212)	(0.182)
Security FE	Yes	Yes	No	Yes	-	Yes
Time FE	No	Yes	-	-	-	-
Sec.*Time FE	No	No	No	No	Yes	No
HC*Time FE	No	No	Yes	Yes	Yes	Yes
R^2	0.0521	0.0540	0.0169	0.0619	0.2832	0.0619
Observations	167,873	167,873	168,201	167,873	134,971	167,873

Sources: ECB SHSS and authors' calculations.

Notes: Standard errors are in parentheses (p < 0.1, ** p < 0.05, *** p < 0.01). Securities are bonds issued by the government sector as defined by ESA (2010) (government sector code starting with S.13). "Net Buy" is the change in the log of the nominal amount of security s held at the end of the quarter t by insurers in holder country hc. "Return" is the quarterly change in the price plus the coupon divided by the price of the security in the past quarter. The regression includes control variables for security s interacted with time t and for holder country hc interacted with time t. To account for heteroscedasticity and autocorrelation of the residuals, two lagged terms of the dependent variable are included as regressors, and standard errors are clustered at the security and holder country level. The estimations are FE panel data models spanning security, holder country and time FE. Significant FE are indicated by "Yes".*

Table 5

Heterogeneity in cyclical investment behaviour – country-level regressions (government bonds)

	Dependent Variable: *NetBuy*					
	AT		BE		DE	
	(1)	(2)	(1)	(2)	(1)	(2)
Return	0.0806**	0.0449	-0.0692**	-0.482	-0.3500***	-0.1098*
	(0.037)	(0.053)	(0.030)	(0.036)	(0.045)	(0.058)
Security FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	Yes	No	Yes
R^2	0.1305	0.1353	0.2215	0.2317	0.1726	0.1940
Obs.	10,482	10,482	10,886	10,886	23,335	23,335
	Dependent Variable: *NetBuy*					
	ES		FR		IE	
	(1)	(2)	(1)	(2)	(1)	(2)
Return	0.0495	0.0059	0.2157***	0.0946*	0.2192**	0.1756
	(0.032)	(0.042)	(0.046)	(0.054)	(0.089)	(0.112)
Security FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	Yes	No	Yes
R^2	0.1311	0.1380	0.1457	0.1485	0.1181	0.1223
Obs.	14,823	14,823	26,363	26,363	23,619	23,619
	Dependent Variable: *NetBuy*					
	IT		LU		NL	
	(1)	(2)	(1)	(2)	(1)	(2)
Return	0.1130**	0.2140***	0.0017	0.0044	-0.4402**	-0.4032***
	(0.055)	(0.072)	(0.089)	(0.096)	(0.063)	(0.075)
Security FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	Yes	No	Yes
R^2	0.1506	0.1547	0.1067	0.1138	0.1621	0.1779
Obs.	20,294	20,294	20,582	20,582	8,705	8,705

	Dependent Variable: *NetBuy*	
	PT	
	(1)	(2)
Return	0.0289	0.1189
	(0.111)	(0.177)
Security FE	Yes	Yes
Time FE	No	Yes
R^2	0.1289	0.1345
Obs.	7,733	7,733

Sources: ECB SHSS and authors' calculations.

Notes: Standard errors are in parentheses (p < 0.1, ** p < 0.05, *** p < 0.01). Securities are bonds issued by the government sector as defined by ESA (2010) (government sector code starting with S.13). "NetBuy" is the change in the log of the nominal amount of government bond security s held at the end of quarter t by insurers in holder country hc. "Return" is the quarterly change of the price plus the coupon divided by the price of the security in the past quarter. The regression includes control variables for security s interacted with time t. To account for heteroscedasticity and autocorrelation of the residuals, two lagged terms of the dependent variable are included as regressors, and standard errors are clustered at the security level. The estimations are FE panel data models spanning security and time FE. Significant FE are indicated by "Yes".*

Table 6

Heterogeneity in cyclical investment behaviour in the first and second quarters of 2020 - interactions (government bonds)

	Dependent Variable: *NetBuy*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Base	Base	Base	Base	Base	Log returns
Covid*Return	-0.0726	-0.1108	-0.0299	0.0150		0.0800
	(0.079)	(0.089)	(0.112)	(0.105)		(0.091)
Covid*Return*BE	0.0651	0.0654	-0.1676	-0.1739	0.7549*	-0.2204**
	(0.105)	(0.115)	(0.139)	(0.134)	(0.452)	(0.110)
Covid*Return*DE	0.9442***	0.8924***	0.2042	0.2310	1.0062**	0.0502
	(0.152)	(0.153)	(0.187)	(0.188)	(0.477)	(0.157)
Covid*Return*ES	0.3367*	0.3483	0.1470	0.1939	0.1477	0.0993
	(0.192)	(0.192)	(0.225)	(0.223)	(0.379)	(0.203)
Covid*Return*FR	0.0128	0.0181	-0.0607	-0.0416	0.4865	-0.0649
	(0.152)	(0.151)	(0.188)	(0.184)	(0.385)	(0.165)
Covid*Return*IE	-0.0025	-0.0021	-0.1918	-0.2036	0.5417	-0.1505
	(0.207)	(0.208)	(0.221)	(0.227)	(0.433)	(0.185)
Covid*Return*IT	0.0730	0.0557	-0.2753	-0.3164	0.2396	-0.3959**
	(0.126)	(0.127)	(0.176)	(0.166)	(0.391)	(0.158)
Covid*Return*LU	0.2798	0.2801	0.2613	0.1825	0.8810**	0.0693
	(0.176)	(0.180)	(0.206)	(0.193)	(0.441)	(0.173)
Covid*Return*NL	0.0780	0.0551	-0.0157	0.0416	1.0252**	0.0341
	(0.158)	(0.166)	(0.184)	(0.186)	(0.450)	(0.151)
Covid*Return*PT	-0.4095	-0.4107	-0.4048	-0.3059	-0.3622	-0.4161
	(0.366)	(0.366)	(0.471)	(0.466)	(0.590)	(0.470)
Security FE	Yes	Yes	No	Yes	-	Yes
Time FE	No	Yes	-	-	-	-
Sec.*Time FE	No	No	No	No	Yes	No
HC*Time FE	No	No	Yes	Yes	Yes	Yes
R^2	0.0529	0.0545	0.0169	0.0620	0.2833	0.0620
Observations	167,873	167,873	168,201	167,873	134,971	167,873

Sources: ECB SHSS and authors' calculations.

Notes: Standard errors are in parentheses (p < 0.1, ** p < 0.05, *** p < 0.01). Securities are bonds issued by the government sector as defined by ESA (2010) (government sector code starting with S.13). "NetBuy" is the change in the log of the nominal amount of government bond security s held at the end of quarter t by insurers in holder country hc. "Return" is the quarterly change of the price plus the coupon divided by the price of the security in the past quarter. The regression includes control variables for security s interacted with time t and for holder country hc interacted with time t. To account for heteroscedasticity and autocorrelation of the residuals, two lagged terms of the dependent variable are included as regressors, and standard errors are clustered at the security level. The estimations are FE panel data models spanning security, holder country and time FE. Significant FE are indicated by "Yes".*

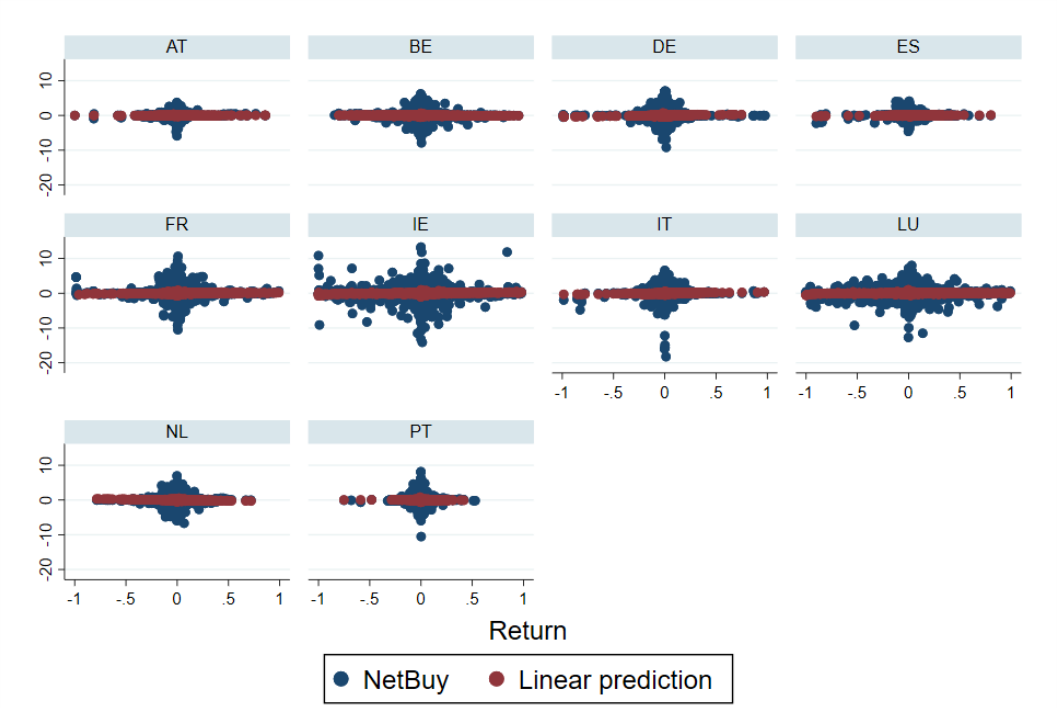
During the COVID-19 shock, European insurers in a few Member States invested procyclically following the definition of Timmer (2018). The positive coefficients for $COVID * Return_{s,hc,t-1} * hc_t$ in the most complete model in column (5) of Table 6 for Germany and the Netherlands show the shock reaction and correspond to the observed behaviour in Chart 6 in Section 3. Whereas Chart 6 shows insurers' net transactions in the first and second quarters of 2020, the regressions consider a lagged reaction to securities' returns. The findings for the Netherlands confirm insurers' reaction to shocks in the literature (e.g., Bijlsma and Vermeulen, 2016) and observed in Chart 10. The findings for Germany must be viewed in the context of the relatively small number of government bonds with ISINs and changes in holdings as shown in Chart 2. The positive and significant interaction terms show that, in the first and second quarters of 2020, German and Dutch insurers reduced their government bond holdings by over 10 percentage points more than Austrian insurers following a negative 10% return in the last quarter. There are also signs that insurers in Luxembourg and Belgium invested procyclically in government bonds during the COVID-19 shock.

The scatterplot showing the actual versus predicted values of the regressions with all bonds confirms our findings on trading intensity in the descriptive statistics in Section 3.2. Chart 11 relates lagged securities' returns (x-axis) to changes in nominal bond holdings (y-axis). The range of returns of securities held by insurers in Ireland and Luxembourg is larger than in other countries, pointing to riskier bond investments. The observations for changes in nominal holdings also spread a lot more in Ireland and Luxembourg, indicating higher trading intensity as illustrated in Chart 9. Conversely, the relatively small changes in nominal holdings in Austria and Spain are in line with the below-average standard deviations in the *NetBuy* variable in Table 2 and the overall insignificant regression results for these countries.

Chart 11

Scatterplot of the regression explaining insurers' investment behaviour with previous period returns

(returns (x-axis) and NetBuy (y-axis); first quarter of 2017 to second quarter of 2022)



Sources: ECB SHSS and authors' calculations.
Notes: "NetBuy" refers to the change in the log of the nominal amount of bond security s held at the end of quarter t by insurers in Austria, Belgium, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. Securities are bonds as defined by ESA (2010) (government sector code starting with S.13, financial sector code with S.12 and non-financial sector code with S.11); n=458,758. "Return" is the quarterly change of the price plus the coupon divided by the price of the security in the past quarter. The regression to compute linear predictions includes control variables for security s interacted with time t and for holder country hc interacted with time t and is an FE panel data model. To account for heteroscedasticity and autocorrelation of the residuals, two lagged terms of the dependent variable are included as regressors.

To identify the reasons for the different investment behaviour of insurers in different countries, firm-level data are needed. Similar research indicates that insurers' capitalisations matter for their investment behaviour. At the onset of the COVID-19 pandemic, a small percentage of German life insurers that would have been unable to fulfil their own fund requirements without transitional LTG measures[41] acted procyclically by being net sellers of risky bonds in the first quarter of 2020, whereas well-capitalised life insurers acted countercyclically (Deutsche Bundesbank, 2021). In Italy, less capitalised insurers on average reduced their exposure to securities whose prices had fallen in the first half of 2020 (Apicella, Gallo and Guazzarotti, 2022).

[41] The transitional measures on the risk-free rate and on technical provisions provide capital relief for insurers by allowing a phasing-in of the valuation differences between Solvency I and Solvency II until 2032; see also ESRB (2018).

To gain insights into how investment behaviour and solvency could be related, we connect SII and SHSS data. Given the lack of firm-level data, Chart 12 is explorative by nature. It relates the average solvency ratios of the 10th percentile of least capitalised insurers to purchases and sales of bonds by insurers. The use of the LTG capital support measures is very heterogeneous across countries, and their impact on average solvency ratios ranges from as low as 1 and 2 percentage points in Ireland and Luxembourg to as much 40 and 47 percentage points in Portugal and Germany as of the fourth quarter of 2019 (EIOPA, 2020b). One reason for these differences may be the heterogeneous insurance product offerings and their respective capital requirements. The points in dark red in Chart 12 indicate countries where the impact of LTG measures on average solvency ratios is larger than 39 percentage points, which corresponds to the 3rd and 4th quartile across countries as of the fourth quarter of 2019.

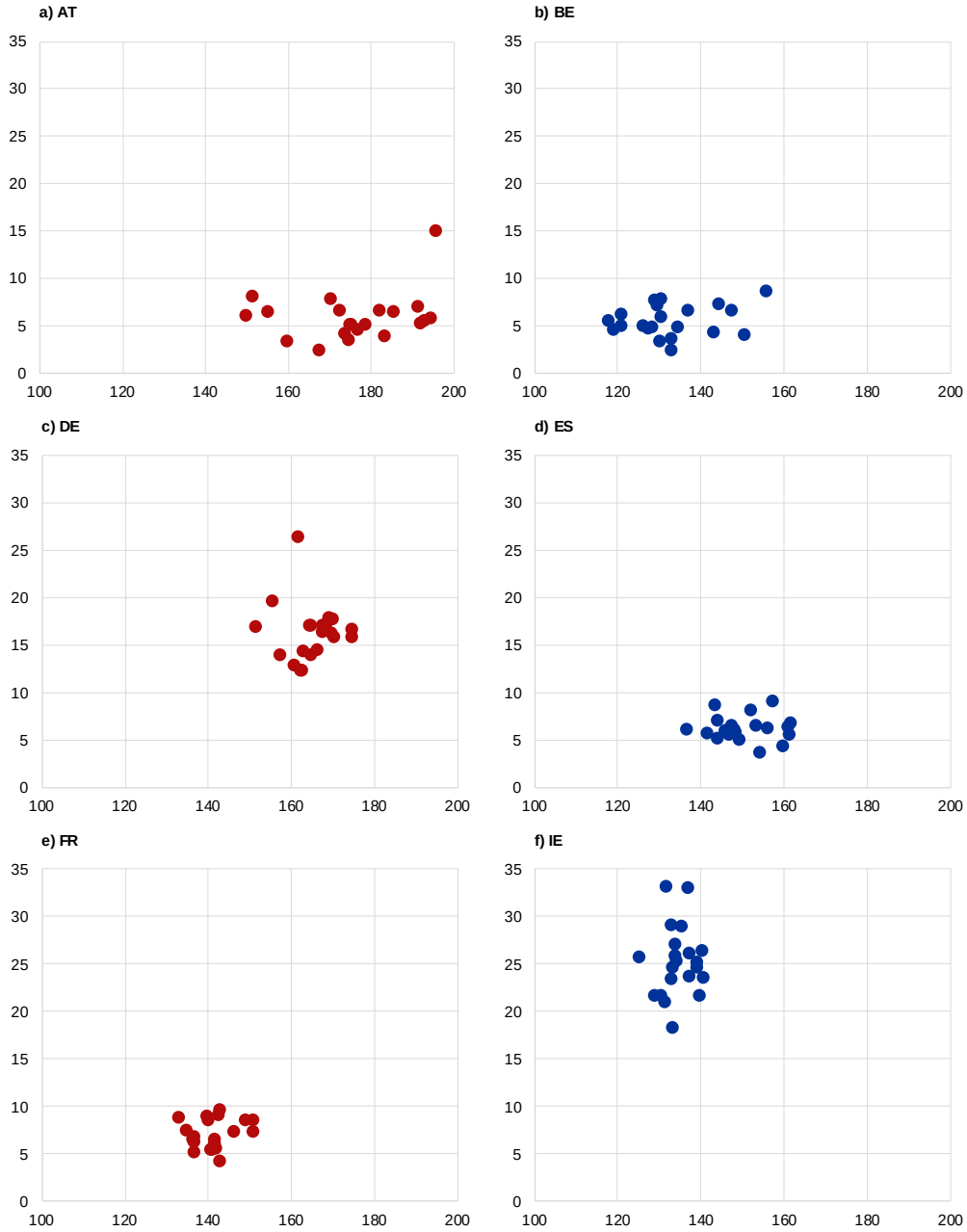
In regressions, however, country-level data on LTG measures have no additional explanatory power as their impact is captured by country FE in our model. As for other stable characteristics of national insurance markets, the overall usage of LTG measures and their impact on average solvency ratios changes only slightly across countries. Variation in the data, however, is a prerequisite for regressions. In addition to the lack of variation in aggregate country-level data on LTG measures, an additional caveat is their annual frequency.

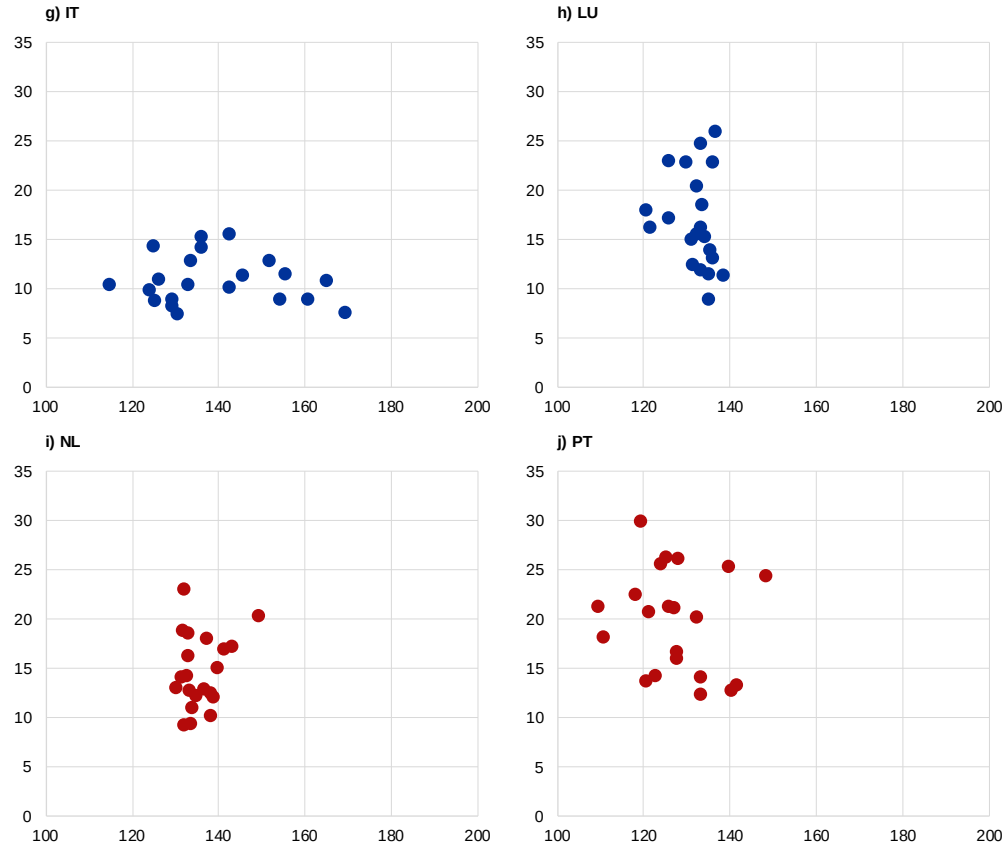
In the absence of firm-level data, distributional country-level data on solvency ratios are a proxy for vulnerable insurers. Therefore, we select the average solvency ratios of the 10th percentile of least capitalised insurers in a country. The variation in transactions and solvency points to interesting insights. First, large changes in transactions (y-axis) indicate active investment strategies. Second, average solvency ratios (x-axis), ranging from 100% to 200%, change more over time in some countries. While it is difficult to draw conclusions about causal effects or correlations, country samples with more variation in solvency ratios may be an interesting study field.

Chart 12

Solvency ratios of the 10th percentile of least capitalised insurers and gross bond transactions

(x-axis: solvency ratios, y-axis: percentages, first quarter of 2019 to first quarter of 2021)





Sources: Public EIOPA insurance statistics, Solvency II reporting template S.23.01 quarterly solo; ECB SHSS; EIOPA (2020a) and authors' calculations.
Notes: Gross bond transactions on the y-axis are expressed as a percentage of previous period holdings at nominal values. The x-axis refers to solvency ratios in percent. Solvency ratios describe the coverage ratios of the solvency capital requirement with insurers' own funds and are averages for insurers in the lowest 10th percentile. Red colour indicates countries where the impact of removing LTG measures on average solvency ratios is larger than 39 percentage points as of the end of 2019.

4.3 Robustness tests

To put our findings on insurers' investment behaviour in perspective, we explore other debt securities than government bonds in the regressions. In doing so, we distinguish between financial and non-financial sector corporate bonds ("FC and NFC bonds"). Their holdings on average are smaller than for insurers' government bonds. As shown in Table A1 in the annex, European insurers on average hold individual financial sector bonds worth €28.2 million and individual non-financial sector bonds worth €19.5 million. Whereas our sample of security-level observations for financial sector bonds (203,693) is nearly as large as for government bonds (208,584), it is substantially smaller for non-financial sector bonds (46,481). Tables A2 and A3 in the annex show the summary statistics for insurers' FC and NFC bond holdings for the national insurance markets.

Different from government bonds, there are no signs of stabilising investment behaviour for financial sector bonds, which substantiates the risk of interconnectedness. On the contrary, on top of procyclical buying or selling in response to last quarter returns in Italy (columns 1-4 and 6) and France (columns 1, 2 and 6), Table 7 indicates a similar investment strategy for Spanish insurers. For example, column (6) indicates that a 10% decline in returns is associated with a 4.1 percentage points reduction in nominal holdings. Whereas there has been a sector-wide trend towards reducing exposure to banks (EIOPA, 2020c), the different behaviour in financial sector bonds may be an indication of interconnectedness and of insurers' reactions to deteriorating credit risk.

Table 7

Heterogeneity in cyclical investment behaviour – interactions (FC bonds)

	Dependent Variable: *NetBuy*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Base	Base	Base	Base	Base	Log returns
Return	-0.1151*	-0.0954	-0.2880	-0.1059		-0.1802
	(0.065)	(0.065)	(0.049)	(0.074)		(0.113)
Return*BE	0.0311	0.0362	0.1144	0.1607	0.7017	0.2538
	(0.129)	(0.128)	(0.109)	(0.141)	(0.461)	(0.160)
Return*DE	0.1642	0.1546	0.1368	0.3834	0.5861	0.3224**
	(0.181)	(0.181)	(0.093)	(0.208)	(0.410)	(0.149)
Return*ES	0.4460**	0.4477**	0.4464**	0.5009*	0.3641	0.5941***
	(0.225)	(0.219)	(0.219)	(0.262)	(0.381)	(0.184)
Return*FR	0.1449**	0.1418**	0.0394	0.1493*	0.2645	0.1936*
	(0.072)	(0.071)	(0.057)	(0.081)	(0.381)	(0.116)
Return*IE	0.0527	0.0537	-0.0625	0.0703	0.6185	-0.1450
	(0.186)	(0.186)	(0.158)	(0.201)	(0.400)	(0.189)
Return*IT	0.3154**	0.8327**	0.3148*	0.3119*	0.5423	0.4703***
	(0.134)	(0.133)	(0.171)	(0.161)	(0.446)	(0.159)
Return*LU	0.2468**	0.2410**	0.1500	0.2481**	0.4495	0.2409*
	(0.100)	(0.099)	(0.091)	(0.110)	(0.392)	(0.124)
Return*NL	0.0453	0.0480	-0.3594*	-0.3890*	-0.4089	-0.1386
	(0.171)	(0.169)	(0.184)	(0.216)	(0.542)	(0.185)
Return*PT	0.0449	-0.0363	-0.0963	-0.0530	0.0086	0.0739
	(0.142)	(0.144)	(0.124)	(0.159)	(0.407)	(0.196)
Security FE	Yes	Yes	No	Yes	-	Yes
Time FE	No	Yes	-	-	-	-
Sec.*Time FE	No	No	No	No	Yes	No
HC*Time FE	No	No	Yes	Yes	Yes	Yes
R^2	0.1122	0.1138	0.0225	0.1192	0.3630	0.1238
Observations	140,983	140,983	142,283	140,983	95,276	140,983

Sources: ECB SHSS and authors' calculations.

Notes: Standard errors are in parentheses (p < 0.1, ** p < 0.05, *** p < 0.01). Securities are bonds issued by the financial corporate sector as defined by ESA (2010) (financial sector code starting with S.12). "NetBuy" is the change in the log of the nominal amount of financial corporate bond security s held at the end of quarter t by insurers in holder country hc. "Return" is the quarterly change of the price plus the coupon divided by the price of the security in the past quarter. The regression includes control variables for security s interacted with time t and for holder country hc interacted with time t. To account for heteroscedasticity and autocorrelation of the residuals, two lagged terms of the dependent variable are included as regressors, and standard errors are clustered at the security level. The estimations are FE panel data models spanning security, holder country and time FE. Significant FE are indicated by "Yes".*

The few findings for insurers' investments in non-financial sector bonds point to opportunistic search-for-yield strategies. Similar to government bonds, insurers in several European countries (Belgium, France, Germany, the Netherlands, and Spain) tend to purchase non-financial sector bonds after periods of negative returns. Further robustness tests to improve the understanding of the drivers of insurers' investment behaviour are needed. These could include regressions with bond yields in excess of risk-free rates and after accounting for credit risk as an explanatory variable to capture liquidity risk. This could support the design of new liquidity risk management tools in the SII review.[42]

Further robustness tests to validate our results on the cyclicality of insurers' investment behaviour during shocks may be conducted in future research. Examples of these robustness tests include using contemporaneous securities returns as an explanatory variable in the regressions. Whereas using previous period returns has its merits for endogeneity, this measure may be less adapted to shocks with opposite movements of returns in consecutive quarters. In addition, conducting tests with a shock dummy variable for a single quarter may yield complementary information.

[42] See Art. 144a and Art. 144b in **Proposal for a directive of the European Parliament and of the Council amending Directive 2009/138/EC as regards proportionality, quality of supervision, reporting, long-term guarantee measures, macro-prudential tools, sustainability risks, group and cross-border supervision**, 22.9.2021, COM(2021) 581 final 2021/0295(COD).

Table 8

Heterogeneity in cyclical investment behaviour – interactions (NFC bonds)

	Dependent Variable: *NetBuy*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Base	Base	Base	Base	Base	Log returns
Return	0.2368*	0.3561**	0.1879	0.0929		0.0883
	(0.138)	(0.146)	(0.137)	(0.145)		(0.145)
Return*BE	-0.4739***	-0.5303***	-0.2939*	-0.2223	-0.2783	-0.2230
	(0.171)	(0.175)	(0.169)	(0.185)	(0.481)	(0.174)
Return*DE	-0.4197**	-0.4024**	-0.1606	0.2526	0.3960	0.2596
	(0.167)	(0.168)	(0.224)	(0.243)	(0.562)	(0.248)
Return*ES	-0.6346***	-0.6339***	-0.4002*	-0.3832	-0.4136	-0.3639
	(0.216)	(0.215)	(0.231)	(0.248)	(0.451)	(0.242)
Return*FR	-0.2744	-0.3245*	-0.1610	-0.1214	-0.0674	-0.1275
	(0.174)	(0.175)	(0.177)	(0.192)	(0.428)	(0.173)
Return*IE	-0.2575	-0.2980*	0.0929	-0.0222	0.1044	0.0272
	(0.162)	(0.167)	(0.200)	(0.178)	(0.427)	(0.160)
Return*IT	-0.2700	-0.2873	-0.1720	-0.1371	-0.0527	-0.1193
	(0.176)	(0.177)	(0.182)	(0.186)	(0.422)	(0.167)
Return*LU	-0.1503	-0.2161	-0.0374	0.0537	0.0514	0.0661
	(0.145)	(0.159)	(0.154)	(0.163)	(0.426)	(0.167)
Return*NL	-0.8537***	-0.8576***	-0.5692*	-0.3809	-0.7625	-0.4392
	(0.209)	(0.214)	(0.310)	(0.340)	(0.878)	(0.349)
Return*PT	-0.3624	-0.3442	-0.3904	-0.2514	-0.0372	-0.2009
	(0.237)	(0.249)	(0.265)	(0.270)	(0.484)	(0.255)
Security FE	Yes	Yes	No	Yes	-	Yes
Time FE	No	Yes	-	-	-	-
Sec.*Time FE	No	No	No	No	Yes	No
HC*Time FE	No	No	Yes	Yes	Yes	Yes
R^2	0.0839	0.0885	0.0226	0.0995	0.3679	0.0996
Observations	31,530	31,530	31,765	31,530	24,209	31,530

Sources: ECB SHSS and authors' calculations.

Notes: Standard errors are in parentheses (p < 0.1, ** p < 0.05, *** p < 0.01). Securities are bonds issued by the non-financial corporate sector as defined by ESA (2010) (non-financial sector code starting with S.11). "NetBuy" is the change in the log of the nominal amount of non-financial corporate bond security s held at the end of quarter t by insurers in holder country hc. "Return" is the quarterly change of the price plus the coupon divided by the price of the security in the past quarter. The regression includes control variables for security s interacted with time t and for holder country hc interacted with time t. To account for heteroscedasticity and autocorrelation of the residuals, two lagged terms of the dependent variable are included as regressors, and standard errors are clustered at the security level. The estimations are FE panel data models spanning security, holder country and time FE. Significant FE are indicated by "Yes".*

5 Conclusion

In this paper, we investigate the impact of the market turmoil at the onset of the COVID-19 pandemic in early 2020 on insurers' investment behaviour. This was the first shock since the inception of the market-based SII regime. We find that, in response to the shock, insurers in 11 EU Member States increased their trading activity to more than €680 billion in the first quarter of 2020. These portfolio adjustments took place to a large extent in European government bonds.

Furthermore, with security-level data over a longer time period and for a cross-country sample, we assess whether European insurers under SII act cyclically in their investments. To this end, we follow the methodology proposed by Timmer (2018). When assessing the cyclicality of investment behaviour, it is important to rule out the possibility that transactions are executed before returns are observed and that these returns reflect the price impact of insurers' transactions. With fixed effects regressions, we find that European insurers act procyclically in particular holder or issuer countries. Indeed, we find differences in investment behaviour across European national insurance markets, with more procyclical behaviour in countries with large direct European government bond holdings and for financial sector bonds. At the same time, we confirm the home bias towards the domestic sovereign found by Fache Rousová and Giuzio (2019b).

Our research is important to generate knowledge about European insurers in multiple jurisdictions operating under the SII framework. It is not without policy conclusions on the time horizon of insurers' investments and may support reviews of the SII regulation. Notwithstanding European insurers' capacity to hold assets in the long term, we find them active and not long-term buy-and-hold investors in most jurisdictions, confirming their role as important financial intermediaries (Brunnermeier and Pedersen, 2009). The implication of this result may be relevant when determining capital requirements for investments, when designing anti-procyclicality mechanisms and, more broadly, when assessing insurers' liquidity risk profile.

To understand the underlying mechanisms of insurers' investment behaviour, firm-level data are needed. Questions for future research include, for instance, whether regulation considering ratings or bond durations leads insurers to invest in a specific manner or whether characteristics such as capitalistic cross-border ties or index-linked and unit-linked business matter. Interesting study fields are national insurance markets with active investment strategies and observations of procyclical and countercyclical behaviour, such as in the Netherlands and Germany. Investigating the relationship between European insurers' solvency positions, their use of long-term guarantee measures and the cyclicality of their investment behaviour are other areas for investigation.[43] For example, Deutsche Bundesbank (2021) identifies procyclical behaviour for those German life insurers that only met their regulatory capital requirements by means of the SII transitional measures, i.e. with SCR ratios below 100% without transitional measures. [44] These

[43] See also Acharya, Philippon and Richardson (2017), who measure systemic risk for insurers by investigating fire sales and solvency risks.

[44] The majority of German life insurers had an SCR ratio above 100% even without transitional measures. With a sample including investments within funds, Deutsche Bundesbank (2021) finds the majority of German life insurers acted countercyclically during the COVID-19 shock. See also Carvalho and Schmitz (2021) on different findings when including investment fund look-through data.

results suggest that strong capitalisation is at least as important from a financial stability perspective as that of mitigating procyclical behaviour. Good capitalisation is thus often a prerequisite for countering systemic risks.

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Annex

A1 Methodology

The ECB Securities Holdings Statistics (SHS) are the main dataset used for the analysis. The ECB SHS include two databases, one related to banking groups (SHSG) and one to holder sectors (SHSS). To include cross-sector and cross-asset analysis, we use the SHSS as a reference database. This database provides quarterly information on securities held by euro area investors at the holder country and holder sector level, broken down by instrument type, issuer country and further classifications. Holdings are reported by the national central banks, while transaction data are also calculated based on the change in holdings not due to price, foreign exchange, and other effects.[45] As opposed to other sector-specific data such as Solvency II (SII), SHSS do not discriminate between investments for index-linked and unit-linked insurance products.

Our analysis focuses on insurers' investment behaviour with respect to bond market segments. Bond market segments are classified according to ESA (2010) as government, financial corporate and non-financial corporate. Concerning the maturity profile and for the descriptive statistics, bonds have been grouped by their residual maturity below one year, from one to five years and above five years to capture short-term, medium-term and long-term debt. All bonds that matured within a quarter were assigned the security status "matured"[46], which is confirmed by other characteristics such as negative residual maturity days.

Assessing the credit risk of insurers' bond portfolios required a more meticulous approach. Holdings and transaction data from SHSS have been merged with ratings data from the Centralised Securities Database (CSDB). Following the methodology of the Deutsche Bundesbank, credit ratings have been allocated to credit quality steps (CQSs) by translating the ratings available in SHSS (or CSDB more precisely) into the CQSs of the SII framework. Ratings considered were issued by the main credit rating agencies for long-term debt in local or foreign currency at the issue and issuer level.[47] Sales of downgraded bonds were identified when sales exceeded holdings in the previous quarter. For example, if a specific bond held in the fourth quarter of 2019 had a CQS 4 and was downgraded to CQS 5 or 6 in the first quarter of 2020, the transactions in this bond are recorded under the new CQS.

Finally, regarding the geographic allocation, securities are grouped by the issuer domicile. This can be "domestic" when the issuer domicile country is the same as the country of incorporation of the insurer, "other EU" when it is not domestic but inside the EU, "UK, US and Japan" when the issuer is domiciled in one of these developed economies and "rest of the world" when it belongs to none of the categories. The analysis for the descriptive statistics also comprises cross-sectoral and

45 The ECB Directorate General of Statistics calculates transactions, together with foreign exchange, price and other changes since 2016.

46 The security status flag (SHSS code *security status*) indicates whether a security is "alive" (active) or not (not active).

47 The three main credit rating agencies are Fitch, Moody's and Standard and Poor's. DBRS by Morningstar is included as a credit rating agency.

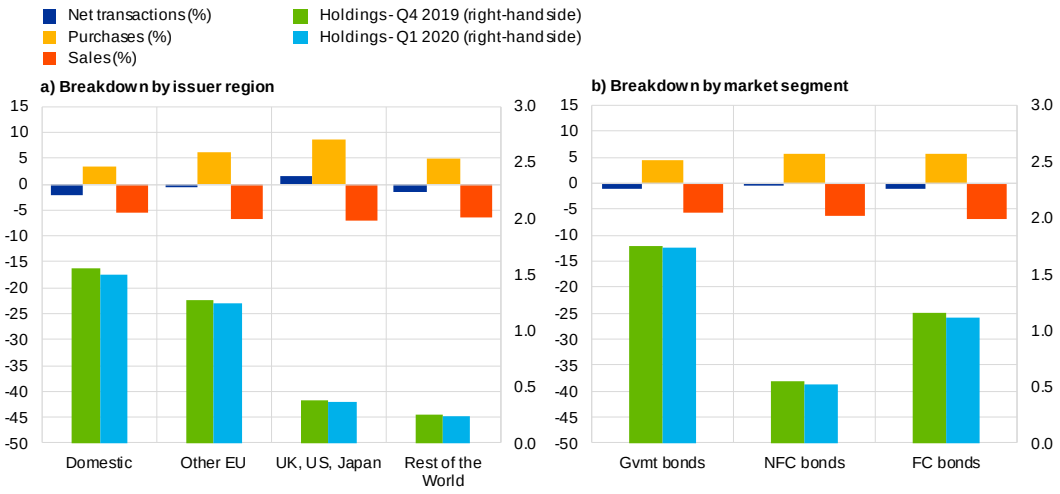
cross-asset class studies. A less granular analysis is conducted at the cross-sectoral and cross-asset class levels (bonds, listed equities, investment funds and money market funds).

A2 Additional analyses

Chart A1

Bond transactions of European insurers by issuer region and market segment

(percentages and EUR trillion, first quarter of 2020)

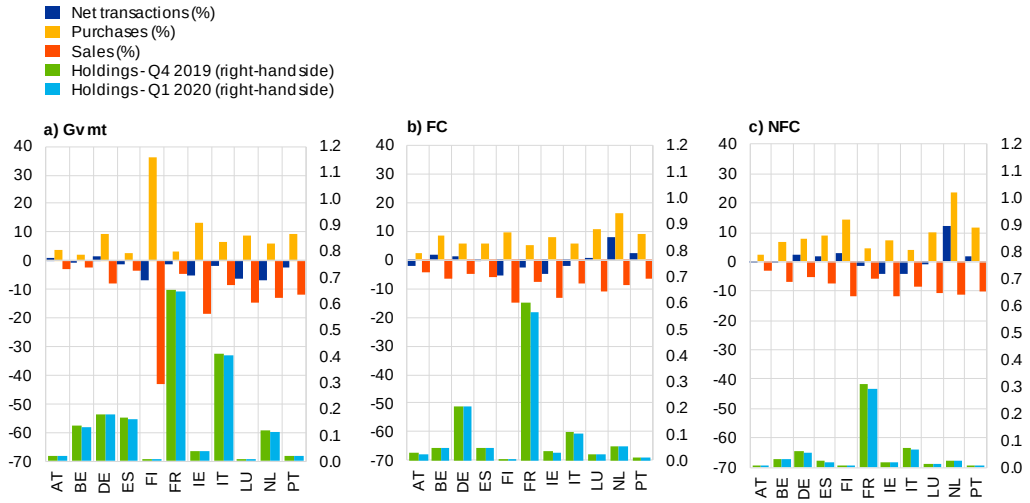


Sources: ECB SHSS and authors' calculations.
Notes: Net transactions, purchases and sales in the first quarter of 2020 are expressed as a percentage of previous period holdings at market value. Sales include matured bonds. Gvmt, FC and NFC represent bonds issued by governments (S.13), financial sector corporations (S.12) and non-financial corporations (S.11) following the ESA (2010) definition. The data refer to insurers in Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain.

Chart A2

Bond transactions of European insurers by bond market segment

(percentages and EUR trillion, first quarter of 2020)

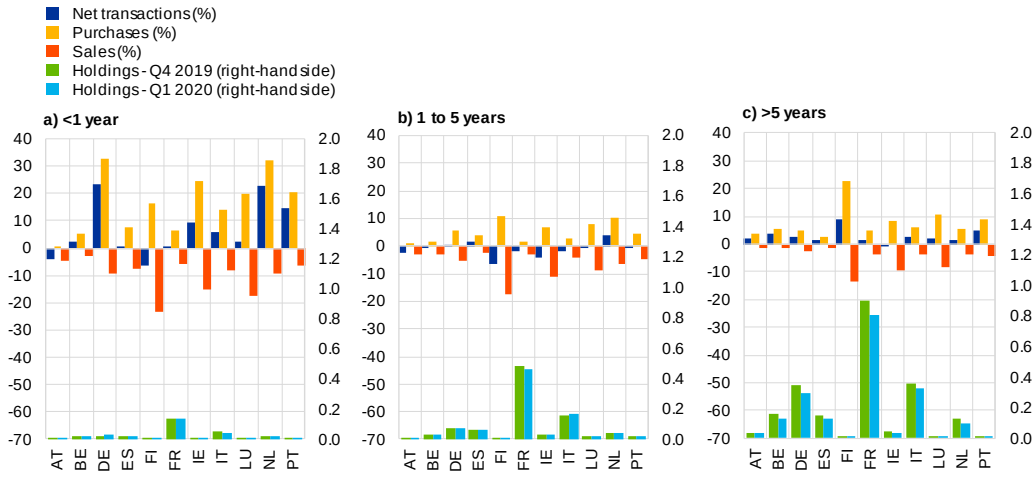


Sources: ECB SHSS and authors' calculations.
Notes: Net transactions, purchases and sales are expressed as a percentage of previous period holdings at market value. Sales include matured bonds. Gvmt., FC and NFC bonds represent bonds issued by governments (S.13), financial sector corporations (S.12) and non-financial corporations (S.11) following the ESA (2010) definition.

Chart A3

Bond transactions of European insurers by residual maturity

(percentages and EUR trillion, first quarter of 2020)

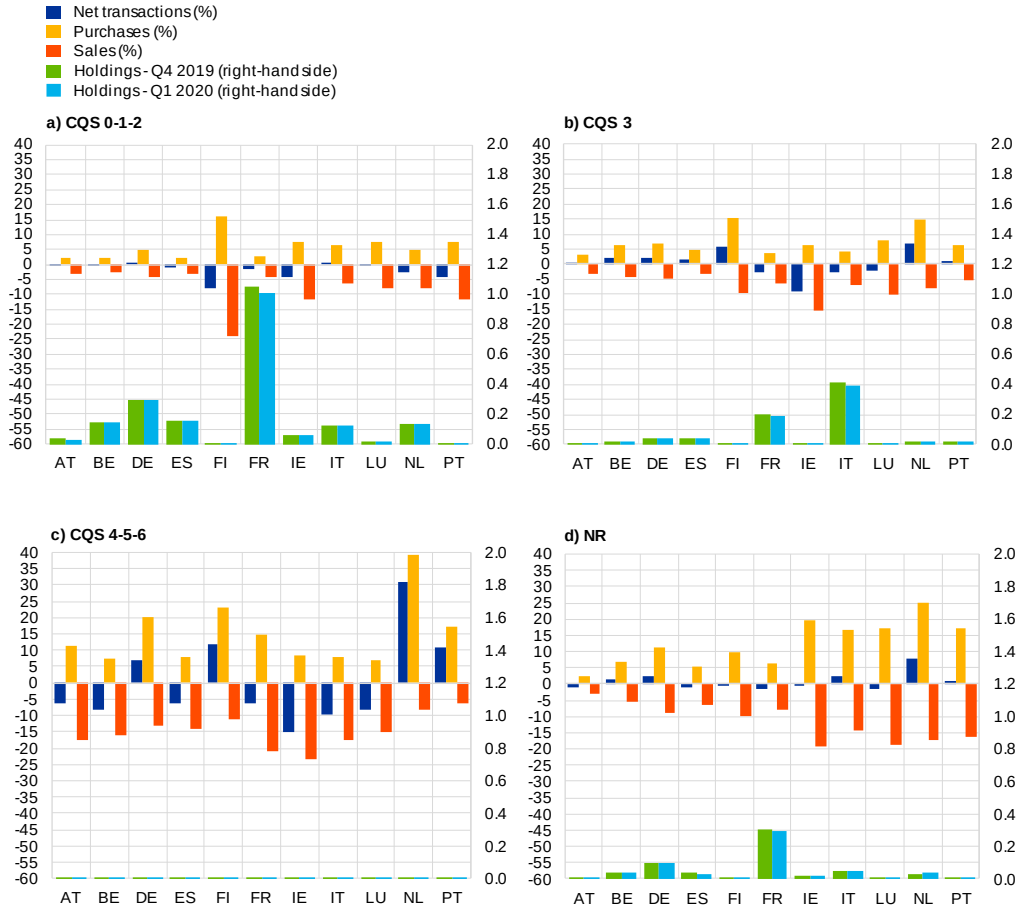


Sources: ECB SHSS and authors' calculations.
Notes: Net transactions, purchases and sales are expressed as a percentage of previous period holdings at market value. Sales include matured bonds. Bonds are government, financial and non-financial sector bonds following the ESA (2010) definition.

Chart A4

Bond transactions of European insurers by credit quality

(percentages and EUR trillion, first quarter of 2020)

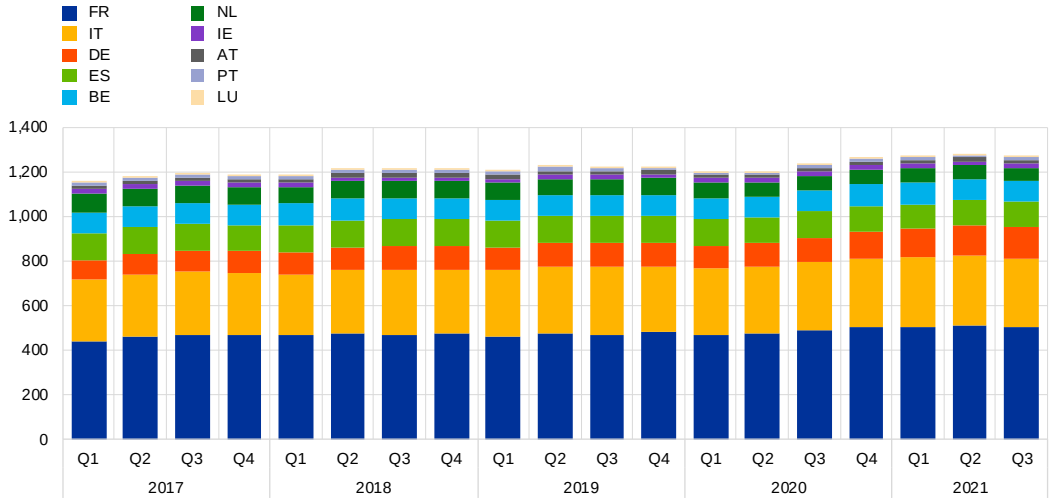


Sources: ECB SHSS and authors' calculations.
Notes: Net transactions, purchases and sales are expressed as a percentage of previous period holdings at market value. Sales included matured bonds. Bonds are government, financial and non-financial sector bonds following the ESA (2010) definition. CQS refers to credit quality step and ranges from 0 (highest, i.e. AAA) to 6 (lowest, i.e. CCC/D); "NR" represents non-rated bonds.

Chart A5

Government bond holdings of European insurers

(EUR trillion, first quarter of 2017 to third quarter of 2021)



Sources: ECB SHSS and authors' calculations.
Notes: Government bonds (S.13) follow the ESA (2010) definition and have a fixed annual or semi-annual coupon and a market or paid price in SHSS.

Table A1

Summary statistics of bond holdings of European insurers

(EUR million and percentages, first quarter of 2017 to second quarter of 2022)

FC bonds							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	28.23	1.13	1.30	-0.007	0.113	0.122	0.006
Median	3.00	0.04	0.05	0.000	0.016	0.020	0.003
Std	101.11	8.18	13.44	0.393	0.367	0.382	0.062
Observations	203,693	99,959	103,734	203,693	99,959	103,734	203,693
NFC bonds							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	19.57	0.64	1.06	-0.006	0.099	0.127	0.004
Median	2.22	0.04	0.05	0.000	0.022	0.024	0.003
Std	59.18	3.03	4.76	0.335	0.288	0.344	0.070
Obs.	46,481	24,852	21,629	46,481	24,852	21,629	46,481

Sources: ECB SHSS and authors' calculations.
Notes: Bonds are as defined by ESA (2010) with sector classifications starting with S.12 for financial corporate bonds and S.11 for non-financial corporate bonds). "Std" refers to the standard deviation. "Holdings" is the nominal value of government bonds held by insurers. "Buy" and "Sell" refer to the amount bought and sold in EUR million. "NetBuy" is the change in the log of the nominal amount held. "Buy%" and "Sell%" are the changes in the log of the nominal amount held if positive or negative, respectively. "Return" is the holding period return defined as the quarterly change in the price plus the quarterly coupon divided by the price in the previous quarter. The sample refers to insurers in Austria, Belgium, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain.

Table A2

Summary statistics of European insurers' FC bond holdings by country

(EUR million and percentages, first quarter of 2017 to second quarter of 2022)

AT							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	13.58	0.22	0.64	-0.010	0.022	0.061	0.003
Median	6.09	0.04	0.09	0.000	0.007	0.016	0.001
Std	24.47	1.22	2.65	0.150	0.089	0.205	0.047
Obs.	12,624	8,017	4,607	12,624	8,017	4,607	12,624
BE							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	12.21	0.91	0.61	-0.001	0.167	0.101	0.008
Median	2.23	0.02	0.13	-0.011	0.041	0.021	0.009
Std	22.76	3.61	1.98	0.362	0.398	0.295	0.055
Obs.	11,096	4,111	6,985	11,096	4,111	6,985	11,096
DE							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	29.66	2.80	3.55	-0.015	0.196	0.198	0.003
Median	5.50	0.16	0.26	-0.005	0.034	0.036	0.003
Std	104.94	10.17	10.11	0.551	0.533	0.498	0.042
Obs.	13,271	6,176	7,095	13,271	6,176	7,095	13,271
ES							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	21.33	0.71	0.92	0.001	0.055	0.055	0.003
Median	8.50	0.03	0.03	0.000	0.003	0.003	0.001
Std	49.51	2.32	4.44	0.193	0.175	0.195	0.040
Obs.	12,715	6,447	6,268	12,715	6,447	6,268	12,715
FR							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	101.55	2.91	2.82	-0.007	0.066	0.063	0.007
Median	22.64	0.13	0.15	0.000	0.009	0.010	0.003
Std	205.85	14.57	26.06	0.298	0.298	0.287	0.063
Obs.	36,891	16,082	20,809	36,891	16,082	20,809	36,891

IE							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	4.10	0.55	0.40	-0.003	0.149	0.146	0.006
Median	1.33	0.02	0.02	0.000	0.023	0.025	0.004
Std	12.91	8.49	7.57	0.495	0.471	0.473	0.079
Obs.	40,199	19,418	20,781	40,199	19,418	20,781	40,199
IT							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	31.19	0.94	1.75	-0.011	0.053	0.102	0.004
Median	12.17	0.10	0.21	0.002	0.008	0.022	0.002
Std	49.81	3.27	4.83	0.287	0.224	0.338	0.036
Obs.	20,444	11,963	8,481	20,444	11,963	8,481	20,444
LU							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	2.60	0.35	0.32	-0.008	0.158	0.164	0.007
Median	0.59	0.02	0.02	0.000	0.030	0.032	0.004
Std	10.53	5.73	9.51	0.430	0.391	0.405	0.072
Obs.	44,144	21,338	22,806	44,144	21,338	22,806	44,144
NL							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	15.73	3.53	2.69	-0.011	0.259	0.269	0.004
Median	7.40	0.50	0.60	-0.003	0.052	0.625	0.002
Std	23.98	9.18	6.41	0.566	0.491	0.510	0.043
Obs.	4,737	2,316	2,421	4,737	2,316	2,421	4,737
PT							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	5.32	0.30	0.43	-0.012	0.069	0.106	0.003
Median	2.01	0.01	0.01	0.000	0.005	0.008	0.001
Std	15.87	1.25	1.69	0.312	0.276	0.325	0.036
Obs.	7,572	4,091	3,481	7,572	4,091	3,481	7,572

Sources: ECB SHSS and authors' calculations.
Notes: Bonds represent bonds issued by financial sector corporations (S.12) following the ESA (2010) definition. "Std" refers to the standard deviation. "Holdings" is the nominal value of bonds held by insurers. "Buy" and "Sell" refer to the amount bought and sold in EUR million. "Net Buy" is the change in the log of the nominal amount held. "Buy%" and "Sell%" are the changes in the log of the nominal amount held if positive or negative, respectively. "Return" is the holding period return defined as the quarterly change in the price plus the quarterly coupon divided by the price in the previous quarter.

Table A3

Summary statistics of European insurers' NFC bond holdings by country

(EUR million and percentages, first quarter of 2017 to second quarter of 2022)

AT							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	7.14	0.14	0.59	-0.020	0.002	0.008	0.002
Median	3.05	0.02	0.05	0.000	0.007	0.018	0.003
Std	10.31	0.61	1.89	0.160	0.079	0.234	0.042
Obs.	1,874	1,201	673	1,874	1,201	673	1,874
BE							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	3.66	0.29	0.42	-0.001	0.146	0.152	0.009
Median	0.13	1.02	0.01	0.001	0.041	0.037	0.008
Std	9.32	0.01	1.83	0.367	0.349	0.366	0.089
Obs.	4,499	2,282	2,217	4,499	2,282	2,217	4,499
DE							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	10.56	1.30	1.50	-0.004	0.145	0.179	0.004
Median	3.99	0.15	0.20	0.006	0.035	0.043	0.003
Std	23.06	5.25	4.53	0.408	0.353	0.400	0.058
Obs.	3,213	1,734	1,479	3,213	1,734	1,479	3,213
ES							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	12.05	0.52	0.57	0.002	0.054	0.057	0.001
Median	5.51	0.01	0.01	0.000	0.002	0.002	0.001
Std	24.82	1.53	2.11	0.186	0.162	0.192	0.041
Obs.	2,607	1,364	1,243	2,607	1,364	1,243	2,607
FR							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	83.20	1.63	3.01	-0.003	0.063	0.069	0.004
Median	21.65	0.12	0.20	0.000	0.017	0.014	0.003
Std	123.48	5.53	9.80	0.267	0.242	0.272	0.067
Obs.	7,541	3,739	3,802	7,541	3,739	3,802	7,541

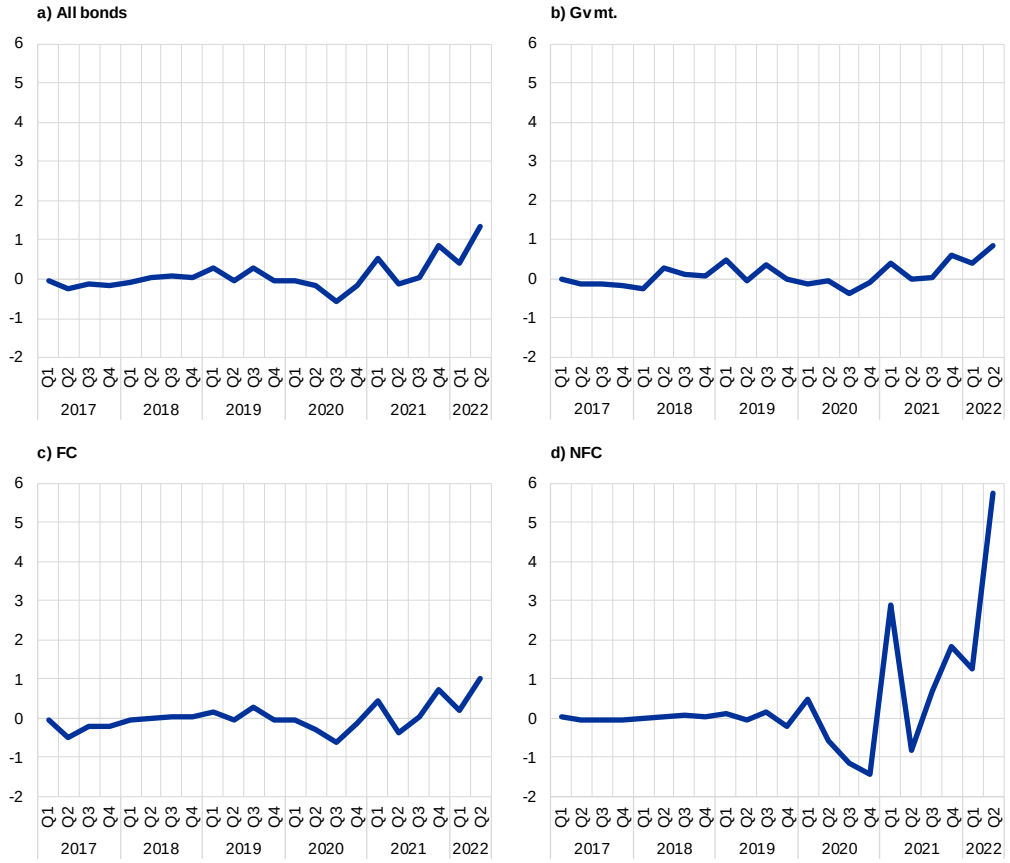
IE							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	2.94	0.22	0.27	-0.002	0.113	0.138	0.004
Median	1.15	0.02	0.02	0.001	0.025	0.026	0.004
Std	4.16	0.70	0.87	0.375	0.324	0.386	0.072
Obs.	9,233	5,022	4,211	9,233	5,022	4,211	9,233
IT							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	22.44	0.59	1.50	-0.014	0.046	0.096	0.001
Median	12.55	0.10	0.24	0.003	0.009	0.023	0.001
Std	31.00	2.31	3.71	0.229	0.177	0.264	0.056
Obs.	5,011	2,891	2,120	5,011	2,891	2,120	5,011
LU							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	2.29	0.17	0.22	-0.013	0.126	0.156	0.006
Median	0.77	0.02	0.02	0.000	0.031	0.034	0.004
Std	4.45	0.68	0.85	0.365	0.309	0.364	0.084
Obs.	8,865	4,495	4,370	8,865	4,495	4,370	8,865
NL							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	10.65	2.00	2.18	0.006	0.191	0.257	0.000
Median	4.35	0.21	0.26	0.021	0.045	0.045	0.001
Std	16.15	5.17	4.96	0.479	0.390	0.472	0.064
Obs.	1,808	1,063	745	1,808	1,063	745	1,808
PT							
	Holdings	Buy	Sell	*NetBuy*	Buy%	Sell%	Return
Mean	4.29	0.46	0.41	-0.014	0.063	0.121	0.000
Median	1.52	0.01	0.01	0.001	0.007	0.010	0.001
Std	8.78	0.94	1.25	0.304	0.226	0.361	0.048
Obs.	1,830	1,061	769	1,830	1,061	769	1,830

Sources: ECB SHSS and authors' calculations.
Notes: Bonds represent bonds issued by non-financial sector corporations (S.11) following the ESA (2010) definition. "Std" refers to the standard deviation. "Holdings" is the nominal value of bonds held by insurers. "Buy" and "Sell" refer to the amount bought and sold in million euros. "Net Buy" is the change in the log of the nominal amount held. "Buy%" and "Sell%" are the changes in the log of the nominal amount held if positive or negative, respectively. "Return" is the holding period return defined as the quarterly change in the price plus the quarterly coupon divided by the price in the previous quarter.

Chart A6

Median changes in nominal bond holdings of European insurers

(percentages, first quarter of 2017 to second quarter of 2022)



Sources: ECB SHSS and authors' calculations.
Notes: Holdings – used to calculate percentages – refer to current and to previous period holdings and are in nominal terms. Bonds are as defined by ESA (2010) (government sector code starting with S.13, financial sector code with S.12 and non-financial sector code with S.11) with fixed annual or semi-annual coupons. All bonds: n= 458,758; Gvmt. bonds: n=208,584; FC bonds: n= 203,693; NFC bonds: n=46,481. Observations of individual bonds (all, government, FC, NFC) are held by insurers in Austria, Belgium, Germany, France, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain.

Table A4

Heterogeneity in cyclical investment behaviour – interactions (domestic government bonds)

	Dependent Variable: *NetBuy*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Base	Base	Base	Base	Base	Log returns
Home*Return	0.0889**	0.0889**	0.0478	0.1243	-0.0620	0.1443*
	(0.032)	(0.032)	(0.090)	(0.088)	(0.187)	(0.084)
Home*Return*BE	-0.4285**	-0.3533*	0.0210	-0.1749	0.0161	-0.1833
	(0.147)	(0.178)	(0.289)	(0.284)	(0.359)	(0.285)
Home*Return*DE	0.1100	0.0884	-0.0007	0.0656	0.0080	0.0787
	(0.110)	(0.093)	(0.386)	(0.391)	(0.533)	(0.382)
Home*Return*ES	0.0252	0.0245	0.0097	0.0107	0.3797	0.0124
	(0.066)	(0.070)	(0.109)	(0.112)	(0.231)	(0.110)
Home*Return*FR	-0.0461	-0.0676	0.1570	-0.0835	0.1303	-0.1102
	(0.061)	(0.052)	(0.135)	(0.132)	(0.220)	(0.130)
Return*IE	0.0173	-0.0021	0.0224	-0.0875	0.5155	-0.0674
	(0.083)	(0.063)	(0.195)	(0.197)	(0.453)	(0.197)
Return*IT	-0.2395**	-0.2962***	-0.4194***	-0.2688**	0.0230	-0.3513**
	(0.091)	(0.087)	(0.150)	(0.123)	(0.225)	(0.125)
Return*LU	-0.0389	-0.2200	-0.3976	-0.7521**	-1.0451	-0.7802**
	(0.103)	(0.220)	(0.285)	(0.308)	(2.539)	(0.306)
Return*NL	0.5573***	0.5169***	0.5259	0.4018	0.0336	0.5306
	(0.124)	(0.130)	(0.395)	(0.364)	(0.513)	(0.363)
Return*PT	-0.6171***	-0.5560***	-0.4039	-0.5823	-0.4938	-0.6927*
	(0.132)	(0.136)	(0.396)	(0.380)	(0.373)	(0.415)
Security FE	Yes	Yes	No	Yes	-	Yes
Time FE	No	Yes	-	-	-	-
Sec.*Time FE	No	No	No	No	Yes	No
HC*Time FE	No	No	Yes	Yes	Yes	Yes
R^2	0.0542	0.0542	0.0171	0.0621	0.2833	0.0621
Observations	167,816	167,816	168,144	167,816	134,919	167,816

Sources: ECB SHSS and authors' calculations.

Notes: Standard errors are in parentheses ($p < 0.1$, ** $p < 0.05$, *** $p < 0.01$). NetBuy is the change in the log of the nominal amount of government bond security s held at the end of quarter t by insurers in holder country hc. Return is the quarterly change of the price plus the coupon divided by the price of the security in the past quarter. The regression includes control variables for security s interacted with time t and for holder country hc interacted with time t. To account for heteroscedasticity and autocorrelation of the residuals, two lagged terms of the dependent variable are included as regressors, and standard errors are clustered at the security level. The estimations are FE panel data models spanning security, holder country and time FE. Significant FE are indicated by "Yes".*

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