Bank of England

Yield curve sensitivity to investor positioning around economic shocks

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Patrick Altmeyer,[1] Lena Boneva,[2] Rafael Kinston,[3] Shreyosi Saha[4] and Evarist Stoja[5]

Abstract

Speculative trading activity may either support efficient market functioning or introduce price distortions. Using granular, daily EMIR Trade Repository data on short sterling futures, we investigate the interaction of speculative trading and macroeconomic shocks on UK yield curve pricing over a 16-month sample period from 2018 to 2020. Our results are largely consistent with efficient market functioning throughout the period, although we find some evidence that short speculative positions amplified yield curve moves in response to Brexit shocks, while long speculative positions had a dampening effect.

Key words: Yield curve, economic data surprises, monetary policy surprises, positioning, market efficiency.

JEL classification: E43, G14.

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1. Introduction

Market participants and central bank economists alike analyse the front end of the yield curve in order to determine market participants' central expectation for the path of policy rates. The Monetary Policy Committee's (MPC's) forecast is conditioned on the first three years of the curve. It matters if the front of the yield curve reflects not only market participants' economic expectations and uncertainties, expressed as risk premia, but also the technical features of the markets in which the yield curve is traded. Market participants frequently emphasise to staff at the Bank of England that investor positions interact with macroeconomic news. This view posits that when market participants receive news contrary to their expectations, they correct their speculative positions and in the process, amplify the corresponding market reaction. If speculative trading activity were capable of changing the level of the yield curve in this way, this would be inconsistent with efficient market functioning. In this paper, we draw on a unique trade repository (TR) dataset available to the Bank of England under EMIR[1] to investigate this hypothesis.

The instrument on which we focus is a short-term interest rate future known as the "short sterling" future. This simple, exchange-traded derivative expresses a view on forward Libor rates at various maturities and for many years has been the principal instrument used by investors to trade views on the front end of the yield curve. These are standardised commodity products that offer investors the greatest combination of liquidity and simplicity for expressing a view on market interest rates. If the yield curve prices efficiently in any market, it should do so particularly in this one. Other instruments such as Treasury Bills, Libor-linked interest rate swaps and repo transactions may also be used to express views on the front end of the curve[2]. But they serve other financial purposes and, in the case of Bills, are particularly difficult to trade actively. Products linked to SONIA - the Sterling Overnight Index Average rate, the UK's risk free benchmark rate - would be preferable in principle to exclude the credit risk component inherent in Libor. However, during our sample period, both SONIA-linked futures and SONIA-linked MPC-dated swaps traded in less liquid markets than short sterling futures[3].

By design, the aggregate position in futures held by all market participants must net to zero. The long position held by an investor on one side of the contract is matched by the short position held by another investor on the other side. However, it is possible that a subset of investors will take a more active position in futures, affecting prices through a simple supply and demand dynamic. If these speculative investors move from a short to a long position, they buy contracts. The increase in demand leads to a higher price and thus a lower yield for the contract. Conversely, when these investors move from a long to short position, they sell their contracts. The increase in supply lowers the price and increases the yield. News about either the state of the economy or monetary policy are likely to be the most important drivers behind speculative investors' positioning decisions.

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[1] Under the European Market Infrastructure Regulation (No 648/2012), mandatory reporting of individual derivatives contracts to UK trade repositories was passed on to the FCA and shared with the Bank of England (see Commission Delegated Regulation (EU) No 148/2013 for reporting details).

[2] Options on short-term interest rate futures can also be used to trade short term interest rate expectations but were not included in our analysis.

[3] Short sterling futures ceased to exist in December 2021 and have been replaced by SONIA-linked futures.

The first hypothesis we investigate is whether investor positioning affects pricing around shocks to economic fundamentals. We call this the *interaction* hypothesis. Our null hypothesis is that speculative investor positioning plays no role at all: the front end of yield curve should price efficiently around these events. Second, we account for the sign of the shock to understand asymmetries in investor reactions. We refer to this as the *unwind* hypothesis. Suppose that some positive (negative) economic news arrives at time t. The news raises (lowers) expectations of an increase in the policy rate and therefore the yield trades higher in the market. A speculative investor who holds a long (short) position stands to make a loss from the moves in the yield curve. Therefore, investors who are using futures to speculate on the future path of the yield curve will re-assess their positions. The news is a prompt for these investors to sell (buy) contracts to reduce or reverse their prior positions. These actions may directly exert further upward (downward) pressure on yields, amplifying the change that has occurred in response to the news. In contrast, investors who make markets in futures contracts or who are using futures contracts to hedge longer-term positions should be relatively insensitive to the change in the value of their contracts triggered by the news about the economy.

We test both of these hypotheses using a panel regression framework in which we regress the daily changes in yields across the set of the most actively traded futures contracts on a set of economic shocks, comprising of surprises in macroeconomic data releases, monetary policy surprises and surprises arising out of the UK-EU trade negotiations (the "Brexit" process was a key political risk factor during our sample period). Finally, we also consider risk sentiment as a driver of yields proxied with a UK equity risk premium (ERP).

Our findings provide some evidence in support of the *interaction* hypothesis but no evidence in support of the *unwind* hypothesis. Over the sample period from October 2018 to January 2020, net positioning around Brexit shocks appears to have affected yield curve sensitivity, but inconsistently with the *unwind* hypothesis. Rather than the effect being determined by the ex-post correctness of positions, it appears that on balance net long positions tend to decrease the marginal effects of shocks in either direction. Conversely, net short positions tend to strengthen the sensitivity of yields to shocks, also in either direction.

By contrast, net positions appear to have no significant impact on the sensitivity of yields to macroeconomic data surprises and only a weak impact around monetary policy shocks. In most respects, the UK yield curve appears to price information efficiently as new information is released to the market.

These findings may be a consequence of the economic environment in which we obtain our data sample. We also show that economic surprises have a particularly weak impact on changes in the yield curve within our sample period. It is possible that our sample covers a period in which macroeconomic data news was less actively traded by speculative investors. Similarly for monetary policy, while investors were likely to have been attuned to any news, policy shocks over the period were small and relatively limited. For much of the period, market participants reported to the Bank of England that they perceived the MPC to be in a holding pattern until uncertainty over the Brexit negotiations abated.

There exists a large body of literature exploring how macroeconomic and monetary policy news drive variation in yields (Gürkaynak, Sack, and Swanson 2005; Faust et al. 2007; Gertler and Karadi 2015; Miranda-Agrippino and Ricco 2018). The consensus suggests that news on macroeconomic fundamentals plays an important role in explaining the behaviour of the yield curve at different tenors, although the significance can vary over time (Swanson and Williams 2014; Altavilla, Giannone, and Modugno 2017;

Eguren Martin and McLaren 2015). Links between short sterling futures prices and shocks to monetary and economic fundamentals are also well established in the literature (Clare and Courtenay 2001; Sun and Sutcliffe 2003; Kalotychou and Staikouras 2006).

Comparatively, the literature on the role of investor positioning is constrained by the limited availability of such data. To the best of our knowledge, our paper is the first to study the relationship between high frequency data on investor positioning and the UK yield curve. Further, we are aware of only one other paper that uses data of comparable (i.e. daily) frequency - Graeb and Straub (2019). In contrast to our results, Graeb and Straub (2019) find speculative positioning in currency markets amplifies the impact of data surprises and monetary policy shocks. Their paper examines a different asset class over a long time frame; by contrast, our sample covers a period of unique political volatility in which the outcome of the Brexit negotiations was a primary focus for markets.

There is a longer tradition of papers that address similar questions with respect to lower-frequency, publicly available data. For example: Klitgaard and Weir (2004) investigate the predictive power of speculative investors' net positions with respect to changes in exchange rate using the US Commodity Futures Trading Commission's (CFTC's) weekly Commitments of Traders Reports. Mogford and Pain (2006) employ a similar approach, but expand the analysis to oil, interest rate and equity market moves. Both papers observe a contemporaneous relationship between price moves and speculative positioning but find little predictive power in speculative positioning at the available frequency. The most relevant paper in this line of enquiry is De Pooter et al. (2021). They find that investor positioning could explain why the transmission of a monetary policy shocks is more pronounced when monetary policy uncertainty is low. While interaction effects with monetary policy uncertainty are not a specific focus of this paper, our sample period coincides with a period of elevated economic uncertainty due to the UK-EU negotiations over Brexit. As such our results around the effects of positioning might implicitly capture any interaction effects with economic uncertainty.

This paper is organised as follows. Section 2 outlines the data used in the analysis. Section 3 outlines the methodology. Section 4 presents our findings and checks for robustness. Finally, Section 5 summarises the paper and offers some concluding remarks. [An Online Supplementary Annex provides further details on the dataset.]

2. Data

2.1 Positioning in short sterling futures contracts

Our sample period runs from October 2018 to January 2020. The start of our sample is restricted by the availability of the positioning data. We close the sample at end-January 2020, just as the Covid-19 outbreak came sharply into focus. This choice reduces the risk of having to manage for a potential structural break in our sample.

Short sterling futures are exchange-traded contracts that allow market participants to gain exposure to the level of market interest rates (specifically the 3-month Libor rate) at an agreed, future expiry date. The contracts have standardised expiry dates in March, June, September and December. This standardisation leads to high liquidity although Figure 1 shows that this primarily applies to the front 6-8 contracts, which roughly cover a 2-year ahead period. By convention, prices for short sterling future contracts at time t are quoted as $p_{m,t} = 100 - y_{m,t}$ where y is the implied 3-month Libor rate at expiration date m. An increase in the price p_m, t therefore reflects lower expected rates at maturity.

This allows us to extract a simple relationship between investor expectations of Libor and their net positioning in short sterling futures contracts. For example, an investor at time $t = 0$ with expectations of lower rates at some future time T, i.e. $E_0(y_{m,T}) < y_{m,0}$, will tend to position herself *long* on short sterling contracts expiring at m: in other words we would expect her to be a net buyer of short sterling futures.

EMIR TR data on short sterling futures is uniquely granular in that it provides transaction-level data about the future's price, maturity, open interest as well as information about the buyer and seller among other key variables.[4] All open positions as at close-of-business on each day within our sample period should be contained in the data. Future work could extend the analysis to intraday positions to reflect the speed at which the yield curve typically moves in response to economic surprises. Drawing on previous analyses of market participants in the dataset conducted by Bank of England staff, we divide the full set of participants into broad categories of investor type[5]. For the purposes of our analysis, we focus on speculative investors, who tend to place large bets on the trajectory of yields in short sterling futures.

Figure 2 summarises the distribution of end-of-day net positions held by the different *buy-side* investor categories over the course of our sample period. As can be clearly seen, the distribution of net positions held by hedge funds and principal trading firms (PTFs) is very different to that of the other investor types. They exhibit the largest outlier positions, i.e. occasions where the group of investors as a whole are positioned either extremely long or short on net terms – and changes in their net positions tend to be more volatile (Figure 3).[6] Analysis at a more granular level shows that the outlier positions in the data are often due to a handful of speculative counterparties taking positions that are material relative to the market as a whole. This is why we have chosen to focus on these investors to model speculative positioning.

Figures 2 and 3 exclude data from the so-called *sell-side* firms – large dealers and banks – as well as Central Counterparty clearing houses (CCPs). Although these reporting categories also exhibit wide variation in their net positions, we exclude them from the analysis in this paper given their intermediary roles in UK rates markets. Future work could seek to identify common patterns of behaviour within and across institutional categories – both in order to probe the significance of these formal classifications and to understand better the evolution of trading practices in the market.

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[4] Over the sample period, 598 unique counterparties were active in the market for short sterling futures.
[5] This is a standardised approach to investor allocation into categories (e.g. Hedge Funds or Asset Managers). Produced on a best-endeavours basis - it is subject to a degree of uncertainty, for example the treatment of insurance groups with asset management subsidiaries.
[6] Systematic funds are a sub-category of hedge funds and consequently included in our analysis. They did not take large positions during the sample period.

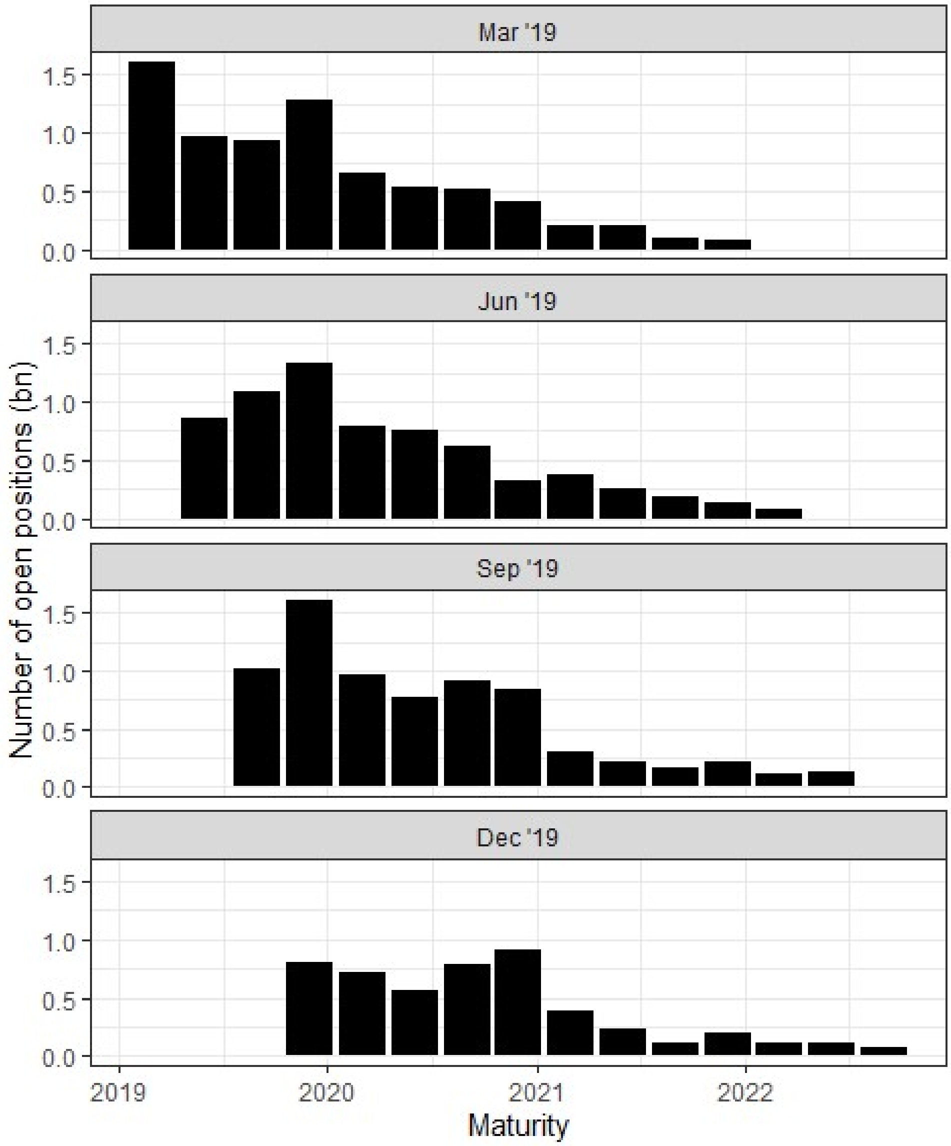

Figure 1 Number of open positions for each contract. Shown here across the conventional 3-year forecast horizon (on the horizontal axis). Each plot shows a stock take of open positions across the maturity spectrum on a specific reporting date. Four illustrative reporting dates in 2019 are chosen. They fall on dates immediately before the expiry dates of the March, June, September and December contracts. Evidently, the majority of open interest is concentrated in the front contracts.

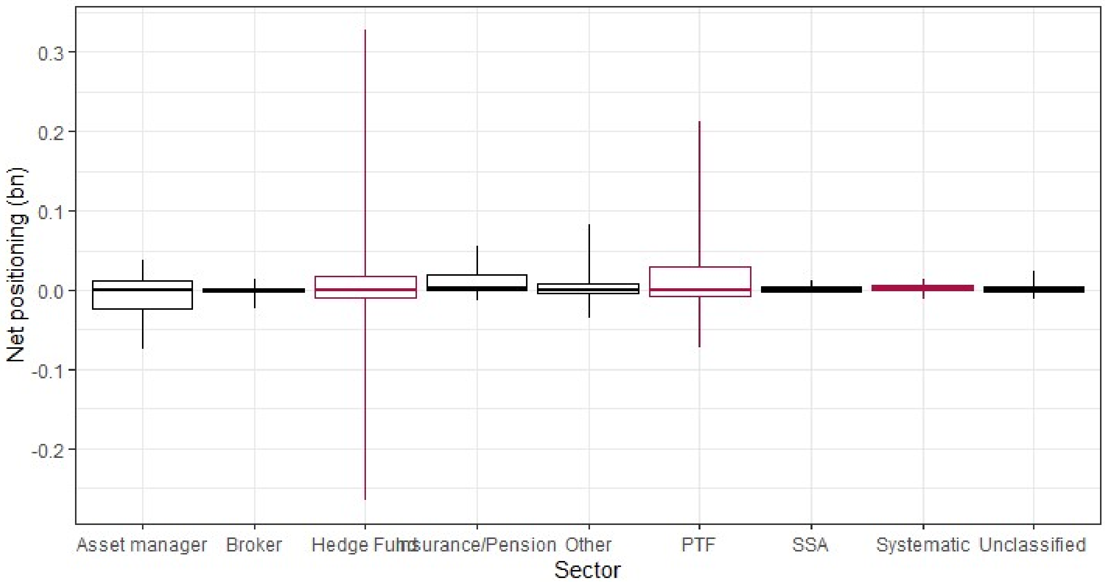

Figure 2 Boxplots of net positions by investor type across the whole sample period. Box areas range from the 10% to 90% quantile. Investors classified as speculative are highlighted in red. Investor types that primarily engage in market-making activities have been omitted.

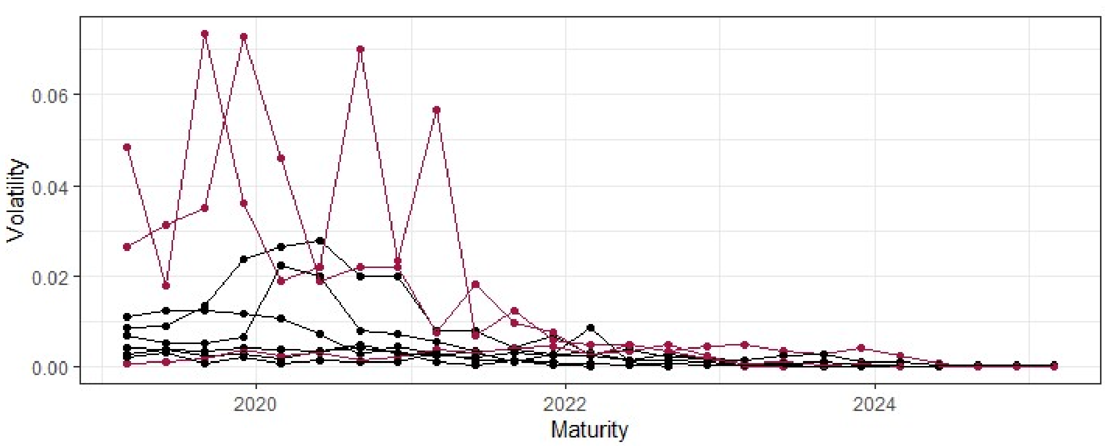

Figure 3 Volatility of net positions. Shown for each contract on the conventional 3-year forecast horizon (horizontal axis) by investor type. Investors classified as speculative are highlighted in red. Investor types that primarily engage in market-making activities have been omitted.

2.2 Economic shock variables

We examine four different types of economic shocks in our analysis: macroeconomic data surprises, monetary policy shocks, Brexit shocks and risk sentiment shocks.

Macroeconomic data surprises measure the extent to which macroeconomic data releases have exceeded or fallen short of market participants' expectations. Data surprises affect financial market participants' view on the economic outlook, which can alter their expectations for future policy rates and therefore market rates (Franklin et al. 2018). In order to accomodate the wide cross-section of data releases, we work with a more parsimonious measure: the Bank of England's internal UK economic surprise index (ESI). This aggregates together a wide cross-section of UK data releases, weighting them by their historical sensitivity with short rates. Section A.1 in the Annex sets out the construction of the ESI in more detail.[7]

Monetary policy shocks measure how dovish or hawkish central bank communications and policy actions have been relative to market expectations. We control for monetary policy shocks using the intraday change in UK 3-year spot rates around monetary policy events.[8] This is in line with a large body of literature which uses high-frequency event-study methodology to identify monetary policy shocks (Gürkaynak, Sack, and Swanson 2005; Hanson and Stein 2015). We follow the approach of Jarociński and Karadi (2020) to separate the monetary policy shocks into pure monetary policy shocks and information shocks about the macroeconomic outlook. The distinction between the two is made based on the intraday reaction in short rates and equities: a hawkish shock which provides news on monetary policy only, should push up on rates but down on equities through the discounting channel.[9] But a shock which provides positive information about the central bank's view of the macroeconomic outlook, should push up on rates *and* equities. Hence, when the intraday reactions diverge, they are considered to be a pure monetary policy shock, and otherwise, an information shock. For our regressions, we only incorporate the pure monetary policy shocks. We include shocks for the UK, US and Euro area, since co-movement in short rates is frequently observed.[10]

Brexit shocks measure the extent to which news on the progress of the UK-EU trade negotiations surprised market participants' expectations around the future UK-EU trading relationship. Over our sample period, participants consistently reported to the Bank of England that Brexit news was a key driver of the variation in yields. We construct Brexit shocks from a log of Brexit-related headlines reported via the Bloomberg news service. Shocks are quantified from the intraday response of a sterling

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[7] An Online Supplementary Annex contains a demonstration of the robustness of our ESI. In addition, it shows that the measure is largely consistent with other widely used indices.

[8] The 3-year point on the curve straddles front-end, near-term and long run rates and, suitably for our purposes, is consistent with the period covered in the MPC's published projections.

[9] Higher real interest rates increase the discount rate applied on future earnings, lowering the present value of earnings and therefore the equity valuation.

[10] Additionally, we trial a specification incorporating dummies for hawkish and dovish shocks, where the dummy classification is based on the intraday reaction. These specifications are not reported but provide equivalent results. We also check specifications using monetary policy shocks based on 1-year and 10-year rates, and using the information shocks. The results were all broadly consistent.

exchange rate index (£ERI) in a thirty-minute window around the publication of the headline.[11] Moves in FX are selected since this asset class has been the most sensitive to Brexit news.

Risk sentiment shocks are measured using daily changes in equity risk premia (ERP) obtained from the Bank of England's dividend discount model (Dison and Rattan 2017): on days where the ERP rises, risk sentiment generally deteriorates often coinciding with a fall in yields. Several caveats apply to this measure: firstly, the ERP is likely subject to a degree of endogeneity with respect to investor positioning; secondly, this is the only shock measure that enters at daily rather than intra-day frequency. Given these caveats, we put less weight on our results for the risk sentiment shock. Nevertheless, the results are reported to provide another angle.

2.3 Implied yields from short sterling futures

Our dependent variable is the implied yield from short sterling futures to be consistent with the positioning data. Yields are derived from the standard short sterling pricing formula given above in Section 2.1:

$$y_{m,t} = 100 - p_{m,t}$$

where $y_{m,t}$ denotes the yield at time t of a short sterling futures contract expiring on date m, and $p_{m,t}$ denotes the corresponding short sterling futures price.

Short sterling futures are based on Libor. Over the sample period, the majority of the trading in UK rates futures markets uses Libor-linked contracts (Figure 4), and the futures market is itself a sizeable portion of the UK rates market (Figure 5). But Libor-linked rates contain some additional risk premia relative to overnight indexed swap rates (OIS). Since OIS rates are likely to offer a more accurate indication of market participants' monetary policy expectations, we additionally run our model using forward OIS rates as an alternative dependent variable.

We construct the forward OIS rates to be consistent with the short sterling contracts, that is a 3-month forward rate with maturity of $(m - t)$, where m is the delivery date of the futures contract and t is the current date. The delivery date is calculated as the first working day after the last trading day in the delivery month; the last trading day is the third Wednesday of the delivery month.[12]

We use short sterling contracts with maturity dates from March 2019 to March 2025. Short sterling prices are obtained from Bloomberg Finance LP. Forward OIS rates are calculated using Bank of England's internally-estimated yield curves.[13]

[11] We use a trade-weighted index of GBPUSD and GBPEUR. In some cases the intraday window was expanded to capture overnight news and gradual pricing of news by market participants; and in other instances it was shortened to avoid cofounding with another news event.

[12] For more information see https://www.theice.com/products/37650330/Three-Month-Sterling-Short-Sterling-Future.

[13] Sources: Bloomberg Finance LP and Bank of England calculations. For more information see: https://www.bankofengland.co.uk/statistics/yield-curves

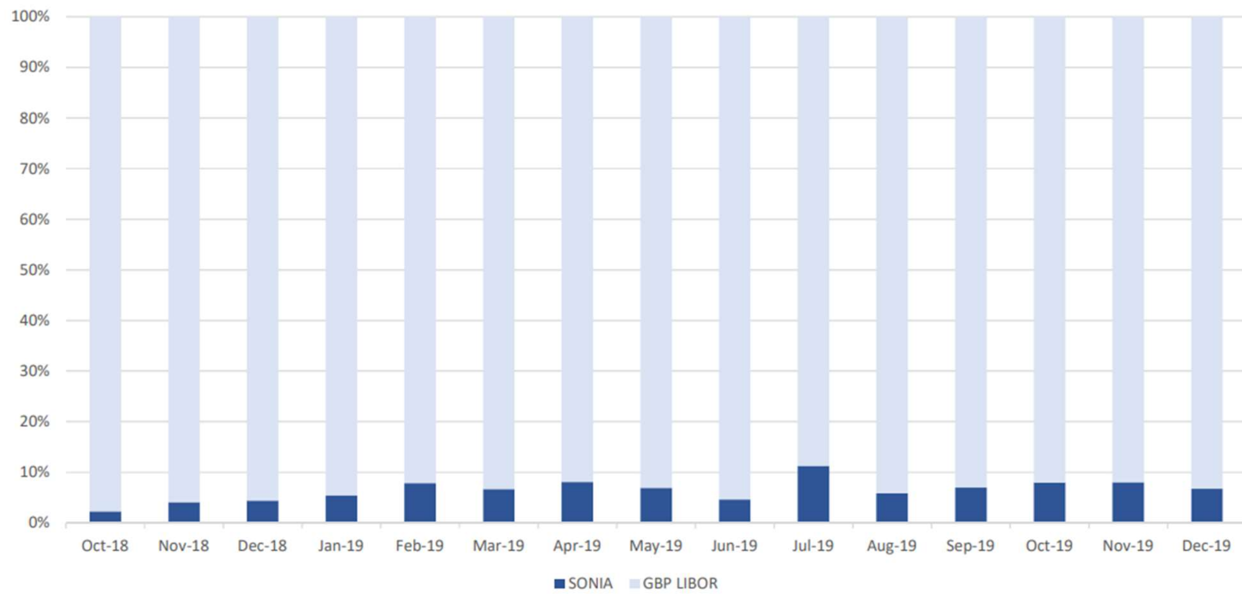

Figure 4 Composition of the UK rates futures market – notional volumes of SONIA and Libor futures contracts (as a percentage of total). *Source: CME Group, ICE, LSE Group*

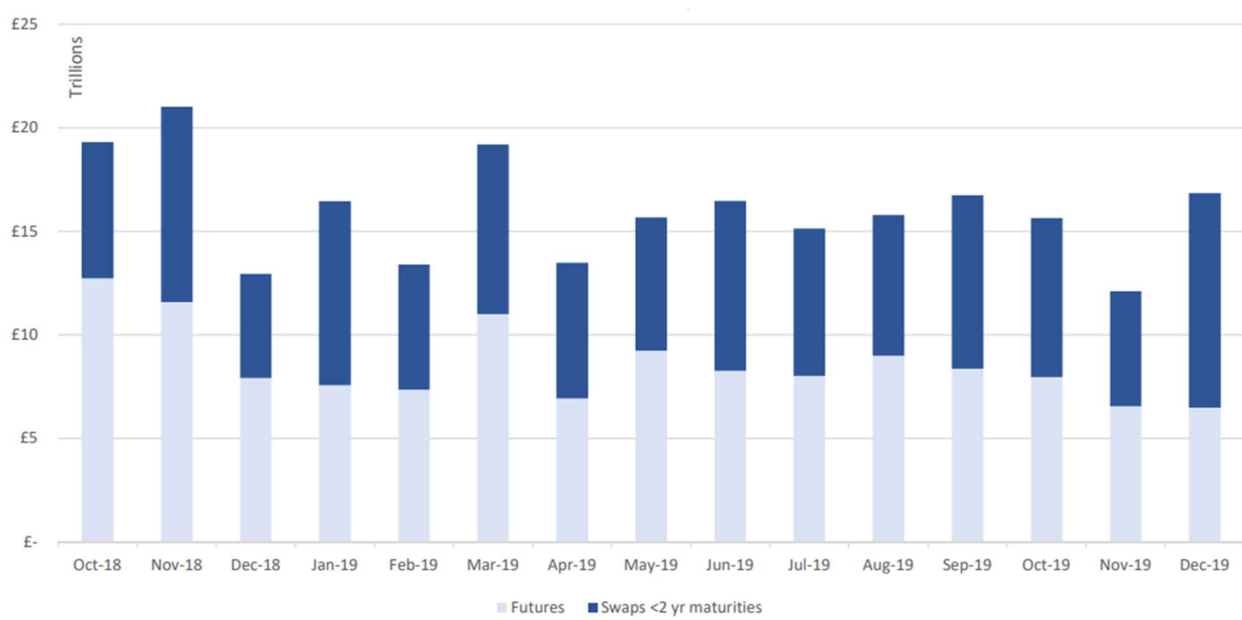

Figure 5 Composition of the front end of the UK rates market – notional turnover of futures and short-dated swaps. *Source: GBP LIBOR and SONIA cleared linear swap data provided by LCH, futures data provided by CME Group, ICE, LSE Group*

3. Methodology

3.1 Benchmark model

To test the *interaction* hypothesis, we estimate the following panel data model:

$$\Delta y_{m,t} = \alpha_m + \beta_1 \Sigma_t^l + \beta_2 \Pi_{m.t-1} + \beta_3 \Pi_{m,t-1}^2 + \beta_4 \Sigma_t^l \Pi_{m,t-1} + \beta_5 \Sigma_t^l \Pi_{m,t-1}^2 + \epsilon_{m,t}$$

$$l \in \left(\Delta UKfx_t^{Brexit}, \Delta UK3y_t^{mp}, \Delta UKesi_t, \Delta UKerp_t\right) \quad (1)$$

$$m \in [1, M]$$

where $\Delta y_{m,t}$ is the daily change in yields on futures contracts dated m at time t; $\Pi_{m,t-1}$ is the lagged net speculative positioning level in the corresponding short-sterling contract; $\Pi_{m,t-1}^2$ is the square of the same lagged net speculative positioning level; Σ_t^l denotes different contemporaneous shock variables: macroeconomic data surprises, Brexit shocks, monetary policy shocks, and risk sentiment; and α_m are fixed effects to control for unobserved heterogeneity across different contracts. Equation (1) applies to each shock variable.

Our primary interest is to understand how lagged speculative positioning levels affect the sensitivity of yields to the various shocks. To illustrate this we focus on the marginal effect in Equation (1):

$$\frac{\partial \Delta y_{m,t}}{\partial \Sigma_t^l} = \beta_1 + \beta_4 \Pi_{m,t-1} + \beta_5 \Pi_{m,t-1}^2 \quad (2)$$

The coefficient β_1 conveys the impact of the shock on yields across all forward contract maturities, absent any positioning by speculative investors, while β_4 and β_5 are informative about how the lagged positioning levels affect the sensitivity of these yields to the shocks. The coefficients of interest are β_4 and β_5 as they speak to the *interaction* hypothesis. In order to reject the null hypothesis that investor positioning does not interact with economic shocks, these values should be statistically different from zero. Including the squared term of positioning controls for non-linearity in the marginal effect. It allows us to assess if extremely short or long net positions affect yield curve sensitivity to a different degree than thin levels of positioning.

3.2 Accounting for the sign of the shock

We assume that investor behaviour at time t depends to some extent on whether at time $t-1$ (before the shock) the investor was positioned in the ex-post correct direction. Faced with a loss-making (or *wrong-way*) position, loss-averse investors are expected to unwind their position to limit losses. Conversely, profitable (or *right-way*) positions are assumed to have a dampening effect as investors are expected to profit-take. Under both scenarios, the investor is expected to unwind existing positions. Figure 6 illustrates how the marginal effect of a positive and negative shock would appear if the *unwind* hypothesis was true.

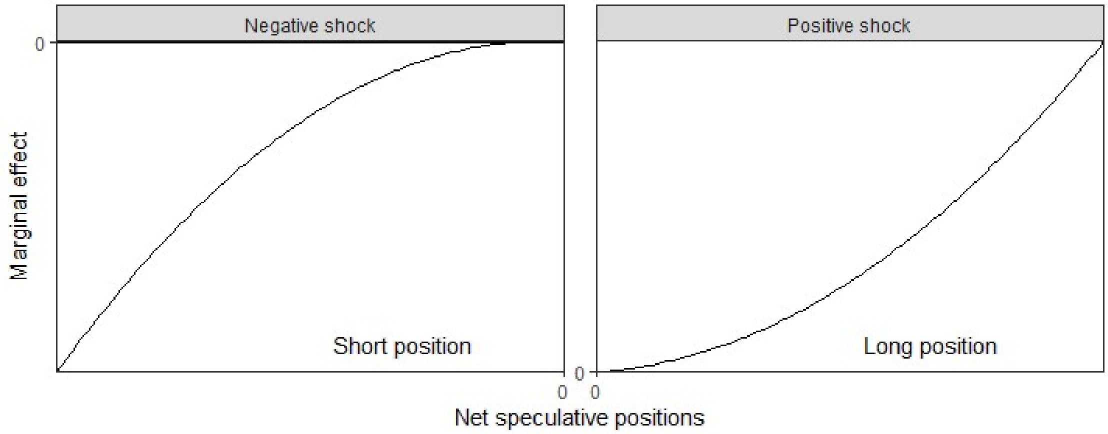

Figure 6 Stylised marginal effects of shocks on yields conditional on wrong-way net positions under the unwind hypothesis. In case of a negative shock, short positions are wrong and the marginal effect is expected to turn more negative, the shorter the net positions are. In case of a positive shock, long positions are wrong and the marginal effect is expected to turn more positive the longer net positions are.

Determining whether an investor is positioned the right-way or the wrong-way is simply a function of their initial position and the subsequent move in yields. For example, an investor's net long position is ex-post right if yields fall in response to the shock and ex-post wrong if they rise. The reverse is true of net short positions. This is not captured in Equation (1).

However, we can re-estimate Equation (1) separately for days with negative and positive shocks. This is straightforward since the ex-post correctness of net positions is unambiguously defined for negative and positive shocks.[14] The benefit of running the model separately for the two subsamples is that it allows us to test for asymmetric responses to positive and negative shocks as in Graeb and Straub (2019). An alternative approach would be to augment Equation (1) by introducing indicator variables for the right-way and wrong-way positions – this approach produces consistent results and is briefly discussed in Section A.3 in the Annex.

4. Results

4.1 The *interaction* hypothesis

Table 1 reports the regression results under the benchmark regression specification for each shock variable. All shocks are entered such that a positive value corresponds with an increase in rates.

The coefficient on the shock term, β_1, can be interpreted as the percentage point change in yields for a positive one standard deviation shock, given net zero speculative positioning. Each of our four shocks produce statistically significant and economically intuitive effects but at different orders of magnitudes. Brexit and risk sentiment appear to have the most economically significant impacts. Given net zero

[14] We rely on the assumption that positive shocks cause positive responses in yields and vice versa.

positioning by speculative investors, a one standard deviation Brexit shock is associated with a 1.4 basis points increase in yields, and a one standard deviation risk sentiment shock is associated with a 2.3 basis points increase in yields. By contrast, a one standard deviation hawkish monetary shock is associated with a 0.7 basis point rise in yields, while the estimated effect of economic data surprises is statistically significant but economically negligible.

Table 1 Benchmark Regression Results

This table presents the results of our baseline regression (1) which we run separately for each shock. In each row, we report the parameter estimates with clustered standard errors in parenthesis.

	Dependent variable:			
	Yield Changes			
	ESI (1)	Brexit (2)	Monetary Policy (3)	Risk Sentiment (4)
Shock (β_1)	0.001*** (0.0002)	0.014*** (0.0003)	0.007*** (0.0004)	0.023*** (0.001)
Positioning (β_2)	0.0003 (0.010)	-0.009 (0.010)	0.002 (0.013)	-0.008 (0.005)
Positioning^2 (β_3)	0.013 (0.025)	0.046 (0.034)	0.024 (0.040)	0.046 (0.030)
Shock × Positioning (β_4)	-0.009 (0.010)	-0.089*** (0.019)	0.013* (0.007)	-0.082* (0.042)
Shock × Positioning^2 (β_5)	0.035 (0.038)	0.195** (0.085)	-0.091*** (0.026)	0.022 (0.164)
Observations	7668	7668	7668	7668
R^2	0.001	0.139	0.036	0.374
Adjusted R^2	-0.003	0.135	0.032	0.372
Residual Std. Error (df = 7638)	0.036	0.034	0.035	0.029
Note:	*p<0.1; **p<0.05; ***p<0.01			

The second and third rows in Table 1 report the coefficients on the positioning terms, β_2 and β_3. Taken together, and assuming no economic shocks on day t, they illustrate the impact on yields at t of a long net increase of a billion contracts from $t-1$ to t. Ex-ante, we do not expect these coefficients to be statistically significantly different from zero: positioning yesterday, in the absence of any news, should not affect yields today. This is indeed what we find in the data.

The next rows report the interaction terms between economic shocks and positioning: β_4 and β_5. To help interpret these coefficients, Figure 7 plots the marginal effect of shocks against the range of speculative positions in our sample. The solid line is the point estimate of the marginal effect ($\frac{\partial y_{m,t}}{\partial \Sigma_{m,t}}$), and the grey band around it is a 90% confidence interval. The dashed horizontal line reflects the effect of the different shocks on yields when net positioning is zero (β_1). When this dashed line overlaps with the confidence interval, this implies there is insufficient evidence that investor positioning affects yield curve pricing around the corresponding shock.

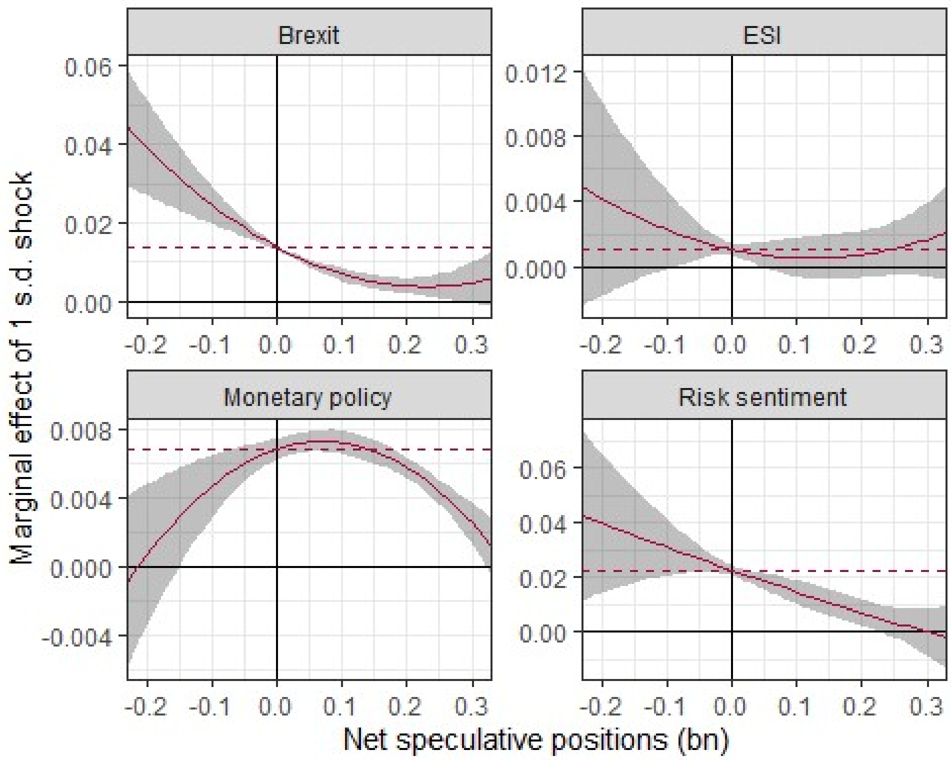

Figure 7 Marginal effect of shocks on yields plotted against the sample range of net positions. In each case the dashed horizontal line reflects the effect of the different shocks on yields when positioning is net zero (the y-axis is in ppts). As long as this line is captured by the 90% confidence interval (grey area) around the point estimate for the marginal effect (solid line), we fail to reject the null hypothesis that investor positioning has no statistically significant effect on yield curve pricing around the corresponding shock.

Reflecting the statistically insignificant interaction terms for economic data surprises, the top-right panel in Figure 7 shows that the confidence interval around the marginal effect of ESIs on yield changes overlaps with the dashed line at all levels of net positioning.

By contrast, the interaction terms for Brexit shocks are significant. In particular, the large positive coefficient on the interaction between positioning squared and the shock indicates that large positions can have a pronounced effect on yields. The top left panel in Figure 7 clearly illustrates this point with respect to net short positions (i.e. positions that profit from higher yields) where a 1 s.d. shock is rapidly amplified above the 1.4bp reaction associated with net zero positioning. The same panel also illustrates smaller net long positions having a dampening effect on the market reaction with the reaction to a 1 s.d. shock falling close to zero. The chart suggests that larger net long positions, outside of our sample, may eventually have an amplifying effect but this does not appear to be statistically significant: at this part of the chart, the confidence interval (grey band) approaches the intercept term (β_1). Naturally, this latter observation may be partly an artefact of our use of a quadratic interaction term which dictates the overall shape of the chart.

The coefficients on monetary policy shocks are also significant – however the impact of positioning around these shocks appears substantially smaller than it is around Brexit shocks. As one can see from the marginal effect curve sloping down at both ends in the bottom right panel of Figure 7, larger positions tend to dampen yield curve sensitivity to policy shocks. This result is due primarily to the squared interaction term which is the larger and more significant of the two coefficients.

Lastly, turning to risk sentiment, the results are similar to those for the Brexit shock. This is not surprising given that UK risk sentiment in the sample period is likely to be influenced by Brexit sentiment. In some respects, it could be viewed as a proxy for Brexit risk sentiment since Brexit was the pre-dominant idiosyncratic UK risk factor. In slight contrast to the Brexit shock, the bottom-right panel of Figure 7 presents a more linear interaction effect and the results are only significant for net long positions.

As discussed in Section 2, we also re-estimate the benchmark model with yields based on OIS as a robustness check. The regression results are presented in Table 3 of Section A.2 and are broadly consistent in sign, magnitude and significance with the estimates in Table 1. The corresponding marginal effect plots are shown in Figure 13. They closely match the plots in Figure 7.

Overall, our benchmark regression results offer mixed evidence in support of the hypothesis that investor positioning materially affects yield curve pricing around economic shocks. The significant results regarding positioning around Brexit and monetary policy shocks clearly indicate some role for investor activity in the pricing of the UK yield curve. However, the absence of interaction effects around economic data surprises is consistent with a view of efficiency in the futures market: positioning generally does not have an effect on yield curve pricing.

As we observe in the Introduction, it is well established in the literature that sensitivity to economic data surprises can vary over time. As our results show, our sample covers a period of particularly low sensitivity to economic data. An alternative interpretation of these results is that over the sample period, risks to the UK economy around the Brexit negotiations were a dominant factor in speculative investors' agendas. Reports from market participants to the Bank of England suggest that the implication of negotiations for the UK economic outlook and the elevated uncertainty around them ensured that developments were critical in forming interest rate expectations. Correspondingly, participants reported that they perceived the MPC to be unlikely to change policy until uncertainty over the outcome had abated. In this context, it is entirely logical for the yield curve to have been less sensitive to macroeconomic data surprises over the sample period. Correspondingly, speculative investors may have chosen not to trade around data releases if they did not expect them to have a material impact on the yield curve. A similar interpretation may be applied to our findings on the impact of monetary policy shocks: relatively few MPC actions or communications materially surprised market participants over our sample period.

4.2 The *unwind* hypothesis

Figures 8 and 9 show the marginal effects for the four types of positive and negative shocks scaled by their corresponding average values. More specifically the plots show:

$$\bar{\Sigma}^{+/-}_{m,t}\left(\frac{\partial y_{m,t}}{\partial \Sigma^{+/-}_{m,t}}\right) \quad = \bar{\Sigma}^{+/-}_{m,t}\left(\beta_1 + \beta_4 \Pi_{m,t-1} + \beta_5 \Pi^2_{m,t-1}\right)$$

where $\bar{\Sigma}^{+/-}_{m,t}$ represents the mean of positive $(+)$ and negative $(-)$ shocks. As before, dashed horizontal lines indicate the effect of shocks on the yield curve assuming that speculative investors net positions are zero. For each scenario, the figures also indicate wrong-way and right-way positioning: recall that when faced with a positive shock that causes yields to increase, net long positions are the wrong way and net short positions are the right way.

Looking first at Brexit shocks, the dashed horizontal line in Figure 8 indicates that the average positive Brexit shock is associated with around a 1 basis point increase in yields. Under the *unwind* hypothesis investors are expected take profits from their net short positions by unwinding some of them following a positive shock. All else equal this would dampen the daily increase in yields. Similarly, wrong-way net long positions would be expected to amplify the increase in yields as loss-averse investors move towards shorter positions. What we observe is the opposite: right-way net short positions appear to amplify the rise in yields - seemingly indicative of investors extending their profit-making positions - while wrong-way net long positions somewhat weaken the effect[15], suggesting that investors may extend or at least hold onto their loss-making positions.

By contrast, Figure 9 shows that wrong-way positions ahead of negative shocks amplify the negative response in yields. The result is marginally significant as the grey band, the confidence interval, is just on the cusp of the dashed line, the β_1 term. Nevertheless, the amplifying effect is consistent with investors moving from shorter to longer net positions and could be indicative of an unwinding of loss-making positions. Conversely, right-way positions appear to a have a significant dampening effect on the fall in yields, consistent with profit-taking action.

A similar picture emerges for negative shocks to risk sentiment, although the amplifying effect of wrong-way positions is not statistically significant (and the results for positive shocks are consistently insignificant). It is only with respect to negative shocks in these two categories that we find evidence that is apparently consistent with the *unwind* hypothesis. Elsewhere the evidence is either weak or non-existent.

In contrast to the results obtained from the benchmark model, the role of positioning around monetary policy shocks is not statistically significant, although a dampening effect from net long positions is observed for both hawkish and dovish monetary policy shocks. We also find that given net zero speculative positioning, data surprises have a small but significant *negative* impact on yields. This is economically counter-intuitive but it should be noted that the effect is negligible. Specifically, an average positive ESI corresponds with a -0.04 basis point increase in yields. This most likely reflects the low data sensitivity during the sample period. Consistent with the *unwind* hypothesis we also see that net long positions appear to amplify marginal effects on larger positions. However, the magnitudes of the parameters are a fraction of those observed on the other shocks. At the maximum levels of positioning observed in our sample, the marginal effect increases to 0.13 basis points. Given the markedly low levels of data sensitivity, it is difficult to put much weight on this result.

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[15] It is worth noting that the order of magnitude of wrong way positions are small and borderline significant.

There is evidence in support of the *unwind* hypothesis for negative Brexit shocks but not for positive shocks. To the extent that the *unwind* intuition is valid, then our findings imply that over the course of this period investors were more likely to believe in negative news, incentivising them to unwind their existing positions either to profit-take or avoid losses. In contrast, news triggering a rise in rates may have been seen as less convincing. Rather than unwinding their positions, investors may have chosen to extend or at least hold on to both profit- and loss-making positions. Such behaviour could be indicative of a perception that the MPC was more likely to ease than to tighten policy over the sample period. If investors are prone to believing that the MPC is more likely to cut than hike policy rates, then they may be more willing to shrug off positive news pointing towards tighter policy and only unwind positions in the presence of negative shocks that are consistent with their beliefs.

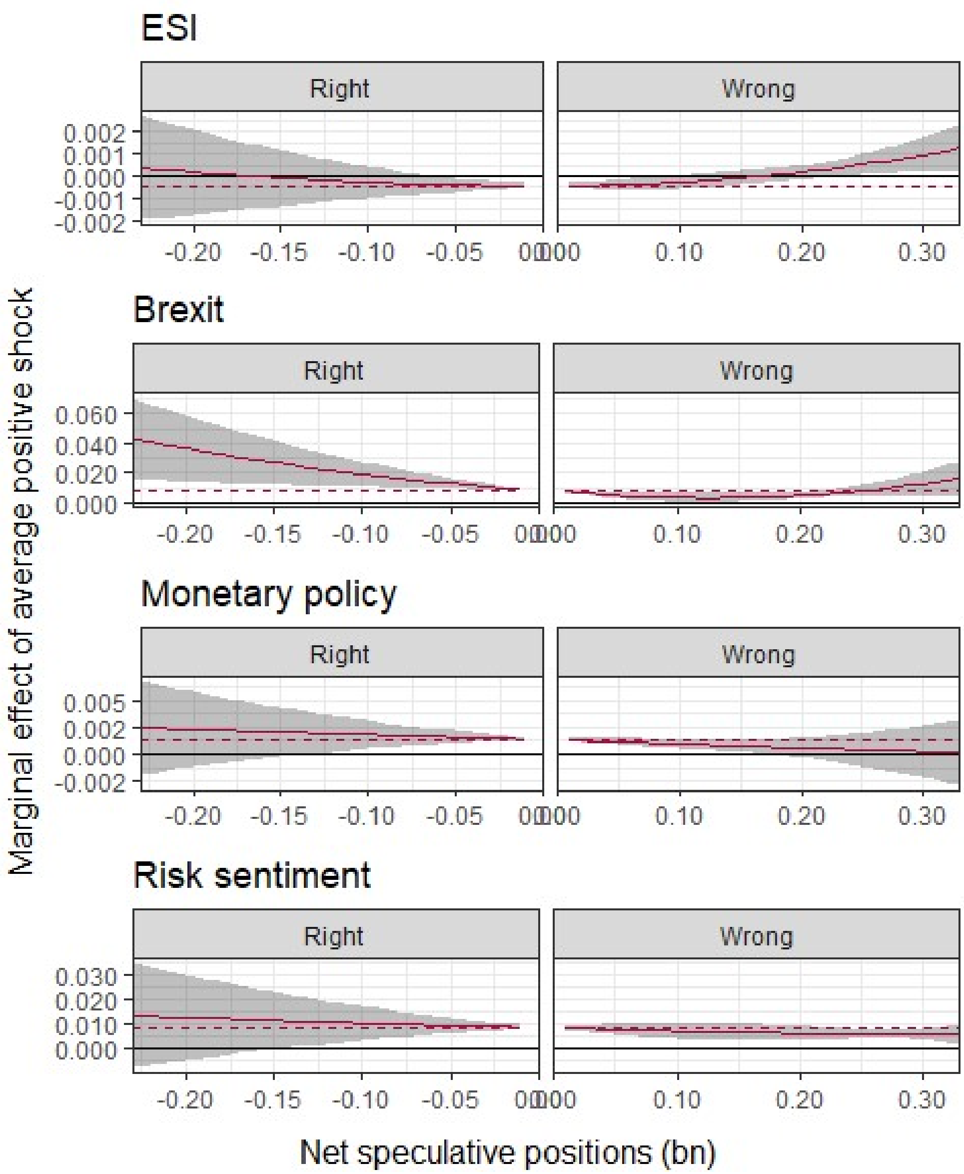

Figure 8 Marginal effect of positive shocks scaled by the average size of positive shocks. Dashed horizontal lines indicate the effect of average shocks on yield changes when net positioning is zero. Wrong- and right-way positions are determined by the expected sign of the standalone effect. With the exception of the ESIs positive shocks have a positive effect on yields and hence short net positions ahead of these shocks are ex-post right-way. Shaded areas indicate 90% confidence intervals.

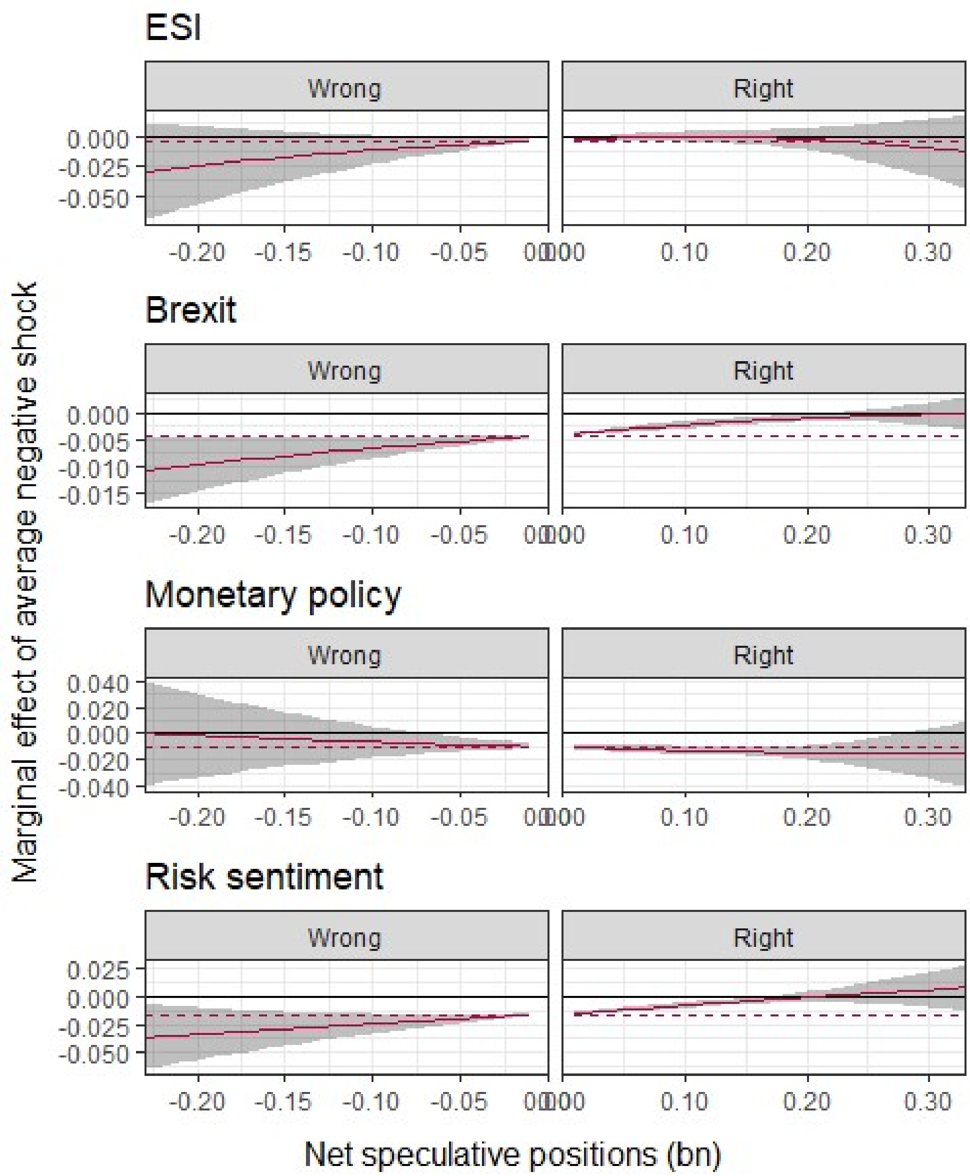

Figure 9 Marginal effect of negative shocks scaled by the average size of negative shocks. Dashed horizontal lines indicate the effect of average shocks on yield changes when net positioning is zero. Wrong- and right-way positions are determined by the expected sign of the standalone effect. Negative shocks have a negative effect on yields and hence long net positions ahead of these shocks are ex-post right-way. Shaded areas indicate 90% confidence intervals.

4.3 Accounting for the distribution of yields - quantile regression

To gain an insight into the role of positioning around economic shocks across the distribution of daily yield changes within the sample period, we re-estimate our benchmark specification (1) using a quantile regression. We follow Koenker (2004) in that we estimate the model simultaneously for the whole set of quantiles with penalised fixed effects.

Estimates for all coefficients are shown in Figure 10. They are broadly in line with our previous results. Specifically, the effects of the shock variables Σ on daily yield changes are consistent with the benchmark results. With the exception of data surprises, the response to shocks is significantly positive across quantiles. The impact of data surprises on yields was similarly negligible in the benchmark model.

We do find some heterogeneity in the overall magnitude of coefficients for different quantiles. For example, the observed response to monetary policy shocks is bell-shaped. That may be explained as follows: on days where overall yield changes are small, the positive intraday responses in yields to monetary policy shocks have a comparatively stronger impact on the daily change. As evident from the intercept estimates, the unconditional bottom (top) quantiles of daily yield changes are the most negative (positive). It should not be surprising that for those observations the estimated intraday responses to shocks have a less significant impact on the daily change, although they still work in the same direction.

On our main point of interest, the interaction of net positioning and the different shock variables, interpretation is again aided by marginal effects plots. Figure 11 shows the estimated marginal effects for each type of shock (rows) given different levels of positioning across the set of quantiles (columns). We again find that net positioning only has a significant effect on the marginal effects of Brexit surprise and shocks to risk sentiment. For those two shocks, the estimated marginal effects take broadly the same shape across quantiles notwithstanding some small differences in magnitude and significance. For monetary policy shocks and data surprises we find no significant impact of net positioning on their marginal effects for any of the quantiles. This broadly mirrors our earlier results.

Finally turning to positioning on its own, Figure 11 shows the quantile-dependent coefficients on Π are heterogeneous. Notably, the pattern across quantiles is linear. As with the interaction terms, coefficients involving only Π cannot be interpreted in isolation of the corresponding coefficients on Π^2. More specifically, we have:

$$\left(\frac{\partial y_{m,t}}{\partial \Pi_{m,t-1}} | \Sigma_{m,t} = 0\right) \quad = \beta_2 + 2\beta_3 \Pi_{m,t-1}$$

The overall non-linear effect depends on the level of positioning. Figure 12 shows the resulting marginal effects. First we observe that an increase in net positioning pushes up (down) on yield changes in the bottom (top) quantiles. Since bottom (top) quantiles of yields changes are negative (positive), this can be read as a dampening effect of long net positions on yield changes. However, this effect becomes insignificant for extremely long positions. This pattern is also observed in our benchmark results for the interaction of positioning with the shock variables; net long positions, i.e. a bet on rates to fall, tend to dampen the effect of shocks on changes in yields, while net short positions tend to amplify the shocks.

Second, the marginal effect decreases from bottom to top quantile almost linearly and on balance is around zero. This is consistent with the lack of a significant result for net positioning on its own in the benchmark model.

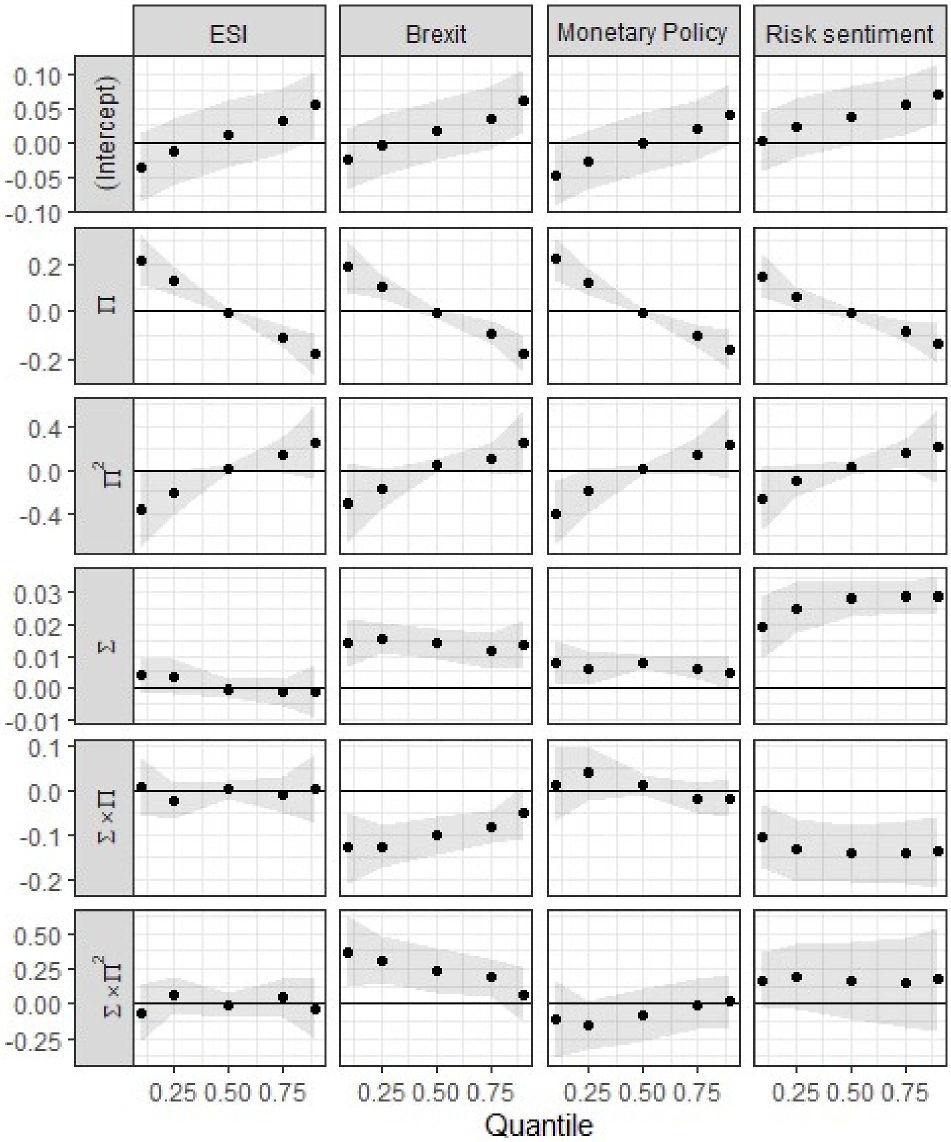

Figure 10 Quantile regression with penalised fixed effects. For each shock variable the chart shows coefficient estimates plotted against the quantile of the dependent variables. Bootstrapped confidence intervals are shown as shaded areas around the point estimates.

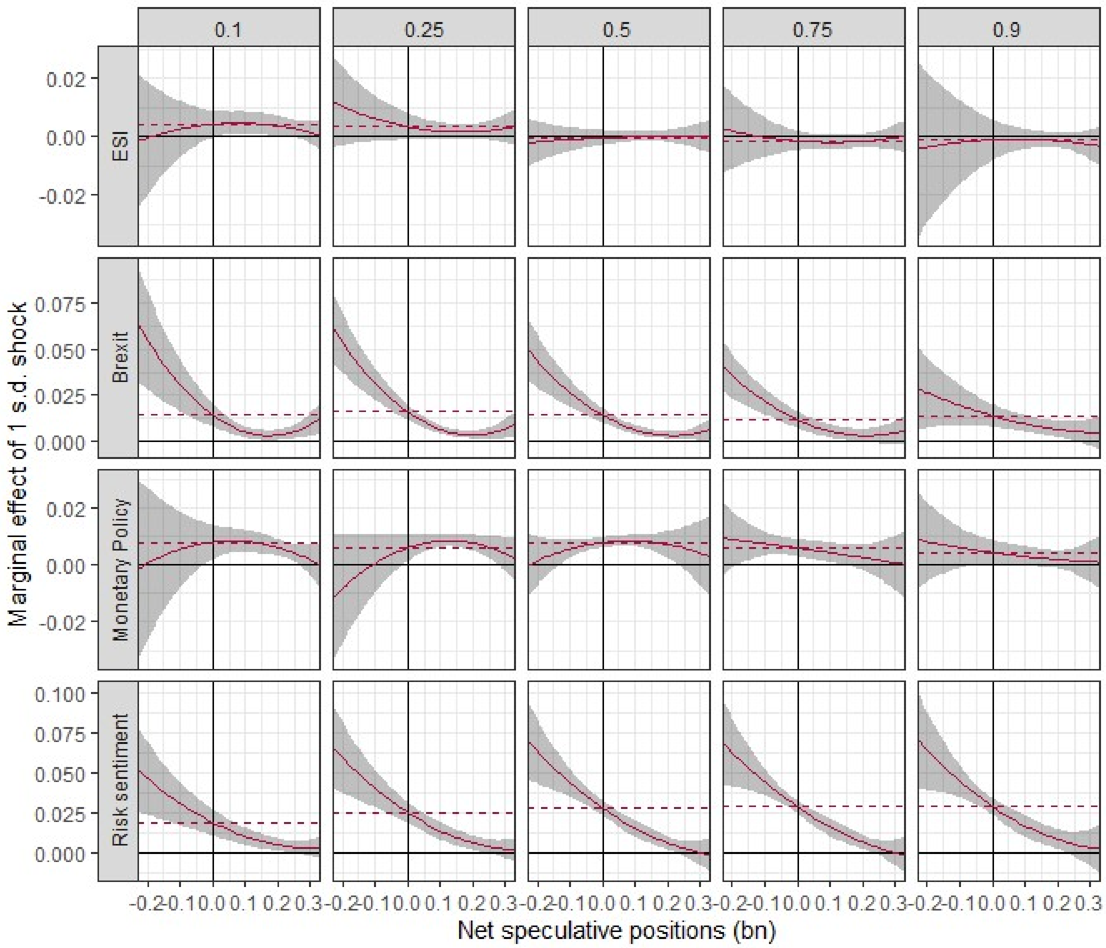

Figure 11 Estimated marginal effects of each type of shocks (rows) for different levels of positioning across the set of quantiles (columns). Dashed horizontal lines indicate the effect of shocks on yields when net positions are zero. Shaded areas are 90% confidence intervals.

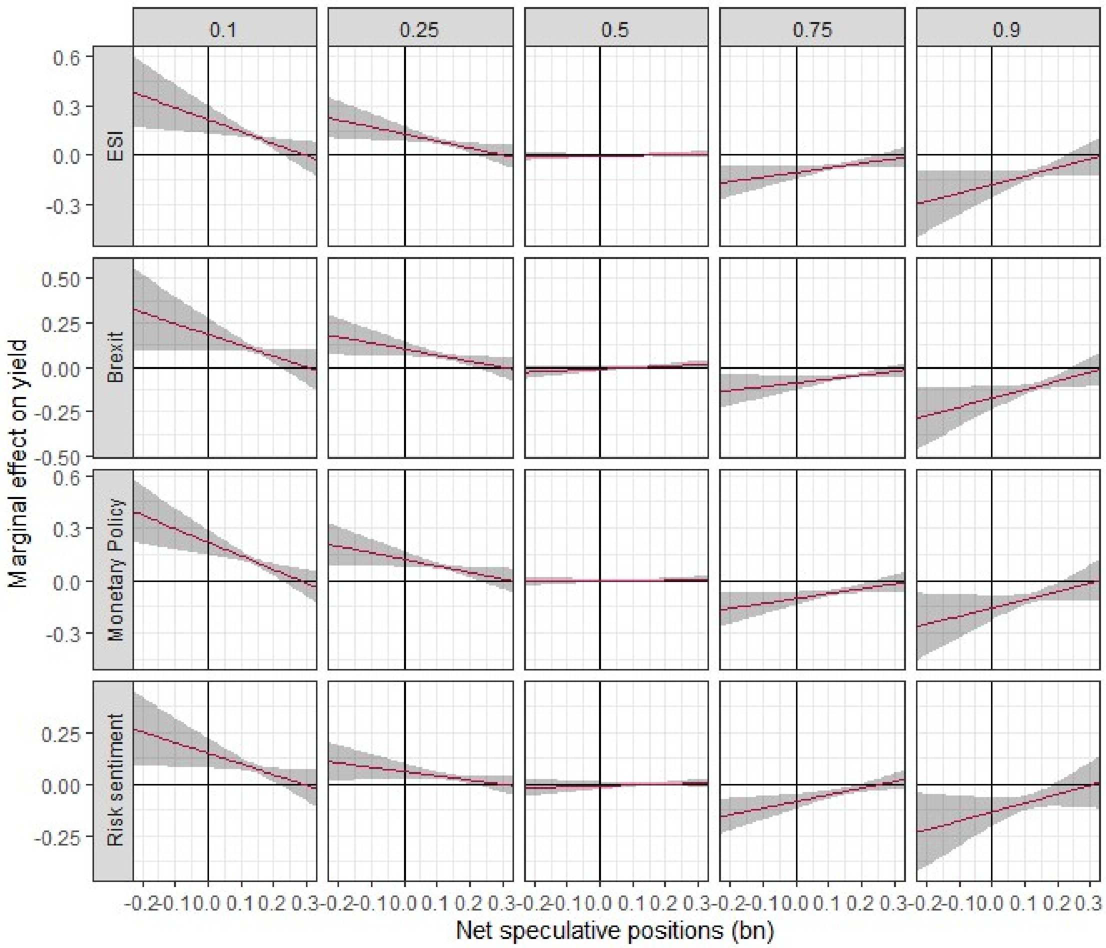

Figure 12 Marginal effect of positioning on yields in the absence of shocks. Each row shows the output for regressions run separately for each type of shocks. Dashed horizontal lines indicate the effect of shocks on yields when net positions are zero. Shaded areas are 90% confidence intervals.

5. Conclusion

In this paper we investigate the effect of net speculative positioning around various economic shocks on yield curve pricing. Our findings show that over the sample period from October 2018 to January 2020, net positioning had little to no impact on the sensitivity of yield to data surprises and monetary policy shocks. With respect to these shocks, we find insufficient evidence that net speculative positioning had an impact on yield curve pricing. The finding that no particular investing advantage pertains to speculative investors in the front end of the UK yield curve is consistent with efficient market functioning.

However a firm, unqualified conclusion on efficient market functioning is incorrect: we find evidence that investor positioning in short sterling futures ahead of Brexit surprises played a role in yield curve pricing. Our analysis shows that net long positions tend to dampen the effect of Brexit shocks on changes in yields, while net short positions tend to amplify the effect of these shocks.

This finding is inconsistent with our hypothesis that wrong-way positioning should be associated with a stronger response in yields and right-way positioning should tend to weaken yield changes around economic shocks. We find that this logic only holds for negative Brexit surprises: at these points in time, as yields tend to fall, wrong-way short net positions tend to amplify the fall in yields, while right-way long net positions tend to dampen the fall in yields possibly due to profit-taking. The relationship reverses for positive surprises, which suggests that investors are slow to unwind their positions to reap profits or avoid losses. There are a wide range of possible explanations for this finding and the interpretation we give should be viewed as an invitation for further research.

Perhaps there is an asymmetry in how investors react to negative versus positive shocks. This sort of behaviour, while not conclusively tested for here, would be indicative of a perception that the MPC was more likely to ease than to tighten policy over the sample period. It is plausible that if speculative investors are prone to thinking that the MPC is more likely to ease policy than hike rates, they will tend to shrug off positive, hawkish shocks more readily than negative, dovish shocks. Investors might be slower to unwind their positions (both short and long) when positive news arrives if the news is discounted in light of a perception that the MPC was more likely to ease than to tighten policy. Conversely, negative shocks could reinforce this perception, driving a rapid unwind of both profit- and loss-making positions.

Several caveats must be taken into account in considering these results. First - the dataset on which this paper relies covers a relatively short sample period that coincided with low interest rates and a degree of political volatility. The results in this paper may identify an idiosyncratic dynamic, specific to the period. If sample-bias is truly at the root of our empirical findings, then future research will overturn the findings as more data becomes available. Second - our dataset is restricted to short sterling futures, which is a subset of the products through which the front end of the UK yield curve is traded. It might not be fully representative of the overall market dynamics: views on the future economic outlook can be traded through other interest rate products and other asset classes. Third – our analysis relies on the assumption that investor positions can be represented by a single point on the yield curve at the end of the trading day. It is common practice to trade the slope or some other aspect of the yield curve over the course of a day. If this behaviour is systematic and dominant within the futures market, then a deeper analysis will be necessary to reveal the interaction between positioning and economic shocks.

Finally, future attempts to shed light on how investors react to macroeconomic surprises would benefit from the development of a more sophisticated theoretical model around belief formation. This could address how investors might process news under different circumstances, for instance when there is elevated uncertainty around the outlook. It could explicitly take into account the behaviours of different investor types and consider the responsiveness and directionality of previous yield curve moves following positive and/or negative news.

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A. Annex

A.1 ESI

We measure the economic surprise for each individual release as the difference between the actual release value and the median expectation reported in surveys published by Bloomberg Finance LP. For each set of data releases, economic surprises are normalised to have standard deviation one. There can be multiple data releases on a day, and even at the same time. So, we need an aggregation method to capture the total news in a day.

One option would be to take a simple average, but this would imply that market participants place equal importance on each data release. Market intelligence suggests some data releases are more important than others. In order to capture that, we generate weights based on a historical regression of changes in yields on individual data surprises. We can infer that those data releases which on average have been associated with larger market reactions are those that market participants judge to be more important.

For the purposes of our analysis, we restrict our attention to UK data releases.[16]

A.1.1. ESI weights

The historically-weighted ESI is calculated using weights from the regression:

$$\Delta y^{intra} = \widetilde{esi}\beta' + \varepsilon \tag{3}$$

where Δy^{intra} is $(J \times 1)$ vector of 10-minute intraday changes in 3-year spot interest rates around data releases, and $\widetilde{esi}$ is a $(J \times (K+1))$ matrix of intraday data surprises and a constant. The subsequent aggregate ESI is calculated as:

$$ESI_t = (esi_{1,t}, \dots . esi_{K,t})(\widehat{\omega}_1, \dots, \widehat{\omega}_K)' \tag{4}$$

where $\widehat{w_k} = \frac{\widehat{\beta_k}}{\sum_i^K |\widehat{\beta_\iota}|}$

We estimate equation (3) using LASSO (least absolute shrinkage and selection operator). LASSO is similar to ordinary least squares but minimises the sum of squared residuals subject to a constraint. While OLS will tend to fit non-zero coefficients on all independent variables, LASSO will be more discriminating and set some coefficients to zero. That is an attractive feature when working with a large cross-section of variables.

Our sample period is 2009 to 2017. We start from 2009 to abstract away from potential structural breaks around the financial crisis, and close it at end-2017 before the sample for our final regression.

Table 2 presents the estimated regression coefficients and corresponding weights.

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[16] The benchmark estimation has also been run for an UK ESI measure that incorporates international data releases. The results for the ESI were equally non-significant.

Table 2 ESI LASSO regression coefficients and resulting weights.

Note that the new monthly GDP release began since 2018. As a result, the historical regressions cannot find a corresponding coefficient. But market intelligence suggests this is a key release. So we treat it by judgement and apply 1/3 of the GDP QoQ advance release weight. It is not as material as the GDP QoQ advance release since the news is received every month, rather than every quarter, so a lower weight than GDP QoQ advance release is justified. And the GDP QoQ advance release is no longer provided so there is no risk of double counting.

Data Release	Coefficient	Weight
GDP (QoQ) A	2.18	0.25
UK CPI EU Harmonised (YoY) NSA	1.30	0.15
Retail Sales ex/Auto Fuel (MoM)	1.00	0.12
New Monthly GDP	0.00	0.08
ILO Unemployment Rate (3mths lag)	-0.58	-0.07
UK CPI ex Energy Food Alcohol & Tobacco (YoY)	0.54	0.06
PMI Services	0.49	0.06
PMI Manufacturing	0.43	0.05
Jobless Claims Monthly Change (thousands, SA)	-0.42	-0.05
Manufacturing Production (MoM)	0.40	0.05
UK average weekly earnings 3mth average growth (YoY)	0.35	0.04
PMI Construction	0.28	0.03
GDP (QoQ) F	0.26	0.03
IP	0.18	0.02
GDP (QoQ) P	0.09	0.01
Mortgage Approvals	0.08	0.01

A.2 Benchmark results

Table 3 Regression Results for yields derived from OIS

This table presents the results of our baseline regression (1) re-run with OIS rates, which we run separately for each shock. In each row, we report the parameter estimates with clustered standard errors in parenthesis.

	Dependent variable:			
	Yield Changes			
	ESI (1)	Brexit (2)	Monetary Policy (3)	Risk Sentiment (4)
Shock	0.0001 (0.0002)	0.011*** (0.0003)	0.006*** (0.0004)	0.022*** (0.001)
Positioning	-0.004 (0.013)	-0.008 (0.011)	-0.0003 (0.015)	0.007 (0.014)
$Positioning^2$	0.017 (0.033)	0.034 (0.030)	0.014 (0.037)	0.023 (0.051)
Shock × Positioning	-0.004 (0.012)	-0.064*** (0.024)	0.013* (0.008)	-0.059 (0.049)
Shock × $Positioning^2$	0.007 (0.050)	0.171** (0.085)	-0.100*** (0.030)	-0.053 (0.190)
Observations	5974	5974	5974	5974
R^2	0.0002	0.076	0.034	0.330
Adjusted R^2	-0.005	0.071	0.029	0.327
Residual Std. Error (df = 5944)	0.037	0.036	0.037	0.031
Note:	*p<0.1; **p<0.05; ***p<0.01			

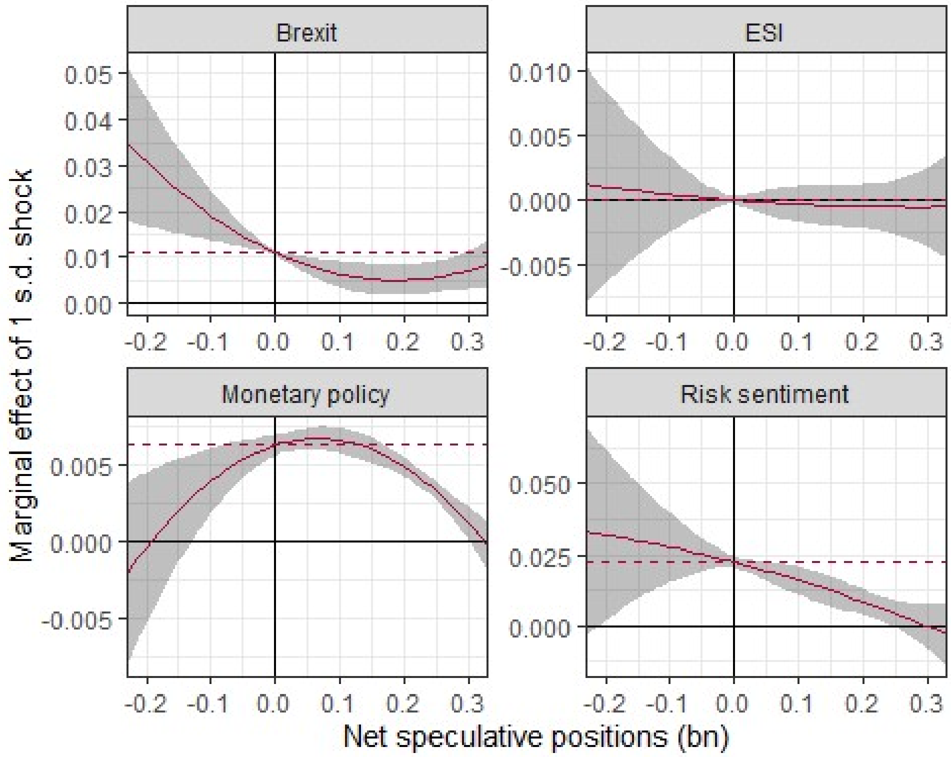

Figure 13 Marginal effect of shocks on yields (OIS) plotted against the sample range of net positions. In each case the dashed horizontal line reflects the effect of the different shocks on yields when positioning is net zero. As long as this line is captured by the confidence interval (grey area) around the point estimate for the marginal effect (solid line), we fail to reject the null hypothesis that investor positioning has no statistically significant effect on yield curve pricing around the corresponding shock.

A.3 Interaction effects with ex-post indicator variable

An alternative approach for testing the *unwind* hypothesis is to augment Equation (1) to explicitly capture right-way and wrong-pay positioning as follows:

$$\Delta y_t = \alpha + \beta_1 \Sigma_t^l + \beta_2 \Pi_{t-1} + \beta_3 \Pi_{t-1}^2 + \beta_4 \Sigma_t^l \Pi_{t-1} + \beta_5 \Sigma_t^l \Pi_{t-1}^2 + \beta_6 \Sigma_t^l \Pi_{t-1}^2 \mathbb{I}_t + \beta_7 \Sigma_t^l \Pi_{t-1}^2 \mathbb{I}_t + \gamma_1 \Sigma_t^l \mathbb{I}_t + \gamma_2 \mathbb{I}_t \tag{6}$$

where we define $\mathbb{I}$ as an indicator variable for post-facto wrong-way positioning:[17]

$$\mathbb{I}_t = \begin{cases} 0 & \text{if } (\Pi_t \geq 0 \wedge \Sigma_t \leq 0) \vee (\Pi_t \leq 0 \wedge \Sigma_t \geq 0) \\ 1 & \text{otherwise - i.e. wrongly positioned.} \end{cases}$$

As in the benchmark model, the squared interaction term allows us to capture non-linearity in the ex-post behaviour of investors with respect to the scale of their prior futures positions.

[17] This indicator variable is defined correctly as long as positive shocks cause yields to increase and vice versa. That is what we observe in the estimates from the benchmark model, so the assumption is robust.

Figure 14 shows the marginal effects of the different types of shocks for wrong- and right-way positions. The *unwind* hypothesis would be supported if the slopes of the corresponding marginal effects have opposite signs. To simplify the presentation we show net long positions only. Here, the marginal effects should lie above the dashed lines to evidence an amplifying effect from wrong-way positions and below the dashed lines to evidence a dampening effect from right-way positions.

Evidently, the estimated marginal effects in Figure 14 do not display this pattern. The results are largely consistent with those discussed in the body of the paper.

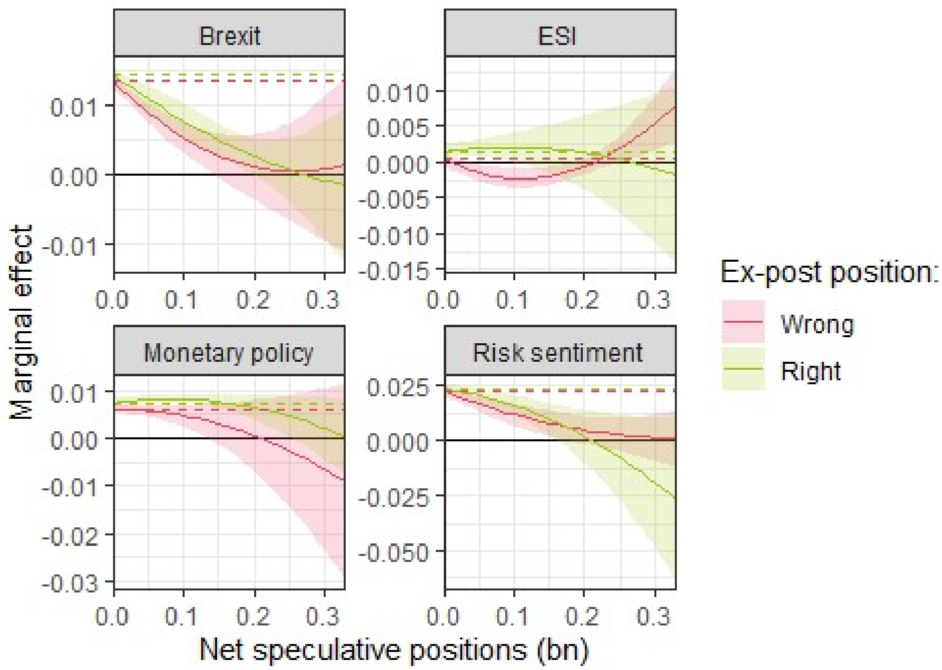

Figure 14 Comparison of marginal effect for wrong- and right-way positions. To simplify the analysis the chart shows long positions only. Under this scenario, if there truly was an amplifying affect of wrong-way positioning and a dampening effect of right-way positioning then the first derivatives of the corresponding marginal effects should be of opposite signs. More specifically, the marginal effects would lie above the dashed lines for wrong-way positions, i.e. amplifying the positive change in yields, and below the dashed lines for right-way positions, i.e. dampening the change in yields.