Asset purchases and sovereign risk premia in the euro area during the pandemic

This paper traces the impact of asset purchases during the Covid-19 pandemic on sovereign risk premia, distinguishing between announcements, expectations, and implementation effects.

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Abstract

We analyse the impact of ECB asset purchases on sovereign risk premia during the Covid-19 pandemic. Using an enhanced event study design, we trace the impact of asset purchases over time, distinguishing between announcements, expectations, and implementation effects. The analysis draws on a new granular cross-country dataset of the ECB's asset purchases and market expectations. We find large announcement effects, particularly in countries with lower sovereign credit ratings. Expectations about the final size of ECB asset purchases ('the stock') and actually implemented net purchases ('the flows') affected risk premia at the time of severe market stress with large cross-country variations. Overall, the ECB's asset purchases were highly effective in warding off risks of financial fragmentation in the euro area during the pandemic.

Keywords: Event study, sovereign risk premia, ECB asset purchases, stock and flow effects

JEL codes: E44, E58, E62, G14

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Abstract

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INTRODUCTION

The economic effects of central bank asset purchases have been a central research topic ever since the onset of large-scale asset purchases in response to the global financial crisis. Findings on the effectiveness of central bank purchase programmes range widely, from highly effective and persistent to moderate and temporary. The Covid-19 crisis provides a unique opportunity to revisit this question for the euro area. That is because the ECB (shorthand for the Eurosystem) embarked on asset purchases of unprecedented scale and pace during the pandemic: (i) it augmented the pre-existing Asset Purchase Programme (APP); and (ii) it launched the Pandemic Emergency Purchase Programme (PEPP). Unlike the previous asset purchase programmes operated by the ECB, the PEPP came with considerable built-in flexibility in the pace, composition, and maturity of purchases. We exploit this particularly rich laboratory to understand better the financial market impact of ECB asset purchase programmes, shedding light on variations across countries and over time.

The main contribution of our paper is to trace the impact of the ECB's purchases of public-sector debt on sovereign risk premia (credit spreads), distinguishing between announcements, pre-announcement expectations, and post-announcement purchases. To this end, we enhance a standard event study method. Traditionally, event studies focus on financial market reactions in a narrow time window when central banks announce information about asset purchases to the public—the announcement effect. But asset purchases can also affect markets *before* the announcement (due to expectations building up) and the actual implementation of asset purchases *after* the announcement.

Our approach seeks to trace the effects over time, from the moment rumours start circulating to the actual intervention in financial markets. As such, the enhanced event study design addresses a common criticism levelled against standard event studies, in that they can under- or overestimate the effect of asset purchases by failing to account for expectations. A by-product of our empirical approach is our ability to characterise the perceived credibility of the ECB's policy response to the pandemic in financial markets.

Our analysis exploits a new granular country-level dataset that combines information about announcements, market expectations and actual purchases by the ECB at a daily frequency. We extract information from the ECB website on actual conducted asset purchases during the pandemic and from Bloomberg Surveys about investor expectations of the ECB's asset purchase programmes ahead of each monetary policy meeting. These data allow us to build a continuous time series of the (average) market belief concerning the future course of asset purchases (including the total size).

Our main empirical findings are twofold. First, we confirm the consensus view that ECB asset purchases were instrumental in lowering the sovereign risk premia of euro area countries during the pandemic (for example, Havlik et al. 2022; and Rostagno et al., 2021). An overwhelming part of the total impact on spreads was due to the announcement effect. Specifically, the announcement of the PEPP, the programme's legal confirmation, and its first recalibration were events that triggered significant decline in risk premia. The cumulative announcement effect displays large cross-country variation, with countries with lower sovereign credit ratings witnessing the largest compression in spreads—Greece and Italy saw declines of approximately 200 basis points (bps).

Second, we show that expectations about the final size of ECB asset purchases ('the stock') and actually implemented purchases after the announcement ('the flow') also affected spreads, although both effects were transient in that they only materialised in the weeks following the inception of the PEPP from mid-March 2020. As the risk premia of less-creditworthy countries widened, expectations were building for an eventual augmentation of the PEPP, while higher-rated countries experienced falling risk premia. The implementation of the ECB's asset purchases (the actual intervention in specific markets on a given day) also helps explain variations in sovereign risk premia in periods of market stress, with significant differences across countries. The transient, but concentrated, role of actual purchases supports the idea that when markets are under stress, financial frictions slow down the process of price formation in the face of new information. Possible frictions include limited attentive capacity for absorbing new information (Sims, 2003), capital constraints (Shleifer and Vishny, 1997), or risk aversion (Vayanos and Vila, 2021).

Announcement effects and a transient role only for the expected total size and actual purchases are the hallmarks of a highly credible policy response. The ECB succeeded in coordinating market beliefs into a "good equilibrium" in which self-fulfilling debt crises are ruled out (Blanchard, 2022; and Lorenzoni and Werning, 2019). And in the "good equilibrium" the marginal impact of actual and expected central bank purchases became negligible. Although expectations for the final stock and purchases evolved and increased, their marginal impact was small, as worries about the "bad equilibrium" had been dispelled. Market prices reflected the belief in the "good equilibrium" (De Santis, 2020; and Gagnon, 2018). In other words, the transient impact of 'stocks' and 'flows' we observe in the data is conditional on the state of the world in which the ECB intervened in markets in line with its publicly declared intentions. The effects of announcements, expected final size, and actual purchase may have well looked differently had the ECB deviated from the publicly communicated course of action.

We discuss our results through the lens of transmission channels of central bank asset purchases. We find the fingerprints of a powerful liquidity/market stabilisation channel. Up to ⅘ of the cumulative impact on announcements occurred in March to April 2020 when markets experienced severe stress. Similarly, changes in the expected final size of asset purchases, as well as the actual implementation, mainly affected spreads in the stress period. Unfortunately, our empirical approach is not well suited to tease apart individual transmission channels. We do not distinguish individual sovereign yield components (such as the liquidity premium in Krishnamurthy et al., 2018) nor do we have information at the security level of the ECB's purchases. The respective strengths of the transmission channels of ECB asset purchases during the pandemic remains an avenue for further research.

Related literature

Our paper builds on the empirical literature on the financial market impact of asset purchases in the euro area (see Annex for an overview of the ECB's asset purchase programmes since the global financial crisis). Early contributions examined the effectiveness of the ECB's Securities Markets Programme (SMP), Outright Monetary Transactions (OMT) programme, and the subsequent Asset Purchase Programme (APP). The general finding is that the programmes had significant effects on yields, particularly for lower-rated sovereigns in the euro area, both on announcement and throughout implementation (Altavilla et al., 2015; Altavilla et al., 2016; De Santis, 2020; Fratzscher et al., 2016; Ghysels et al., 2017; Eser and Schwab, 2016; Krishnamurthy et al., 2018; Urbschat and Watzka, 2020).

A growing body of literature focuses on the ECB's asset purchases during the pandemic. These studies confirm a powerful effect of ECB asset purchase announcements on sovereign yields (Fendel et al., 2021; and Rostagno et al., 2021) and risk premia (Corradin et al., 2021; Delatte and Guillaume; 2020; and Havlik et al., 2022). We improve the pandemic-related event studies in three ways. First, the control for pre-announcement expectations and post-announcement implementation to capture the effects over the entire implementation cycle. Our approach to measuring expectations is similar to Rostagno et al. (2021)'s in that we use Bloomberg Survey information and interpolate between survey observations. Rostagno et al. (2021) switched sources in 2019 to use the ECB's Survey of Monetary Analysts, which has only been publicly available since 2021. We use a single survey source and measure expectations up to mid-2021. Second, we consider a comprehensive set of asset purchase events throughout the pandemic, including important speeches by members of the ECB Governing Council and the recalibration of the PEPP in December 2020. The majority of the asset purchase events in Rostagno et al. (2021) and Havlik et al. (2022) are from the pre-pandemic period and their sample stops in mid-2020 (as does Fendel et

al.'s, 2021). Third, we consider a broad set of sovereign issuers in the euro area, and not only the large EA4 countries. Our empirical method is flexible in estimating country- and time-varying effects, so we reduce risks of imposing possibly arbitrary homogeneity assumptions.

Our findings of large announcement effects but transient implementation effects are also related to the long-standing debate about the relative importance of 'stock' and 'flow effects' of asset purchase programmes (see Altavilla et al., 2021; De Santis and Holm-Hadulla, 2020; and De Santis, 2020 for results for the euro area and Bernanke, 2020 for a general overview). The 'stock effect' captures the notion that sovereign bond prices depend on the 'final stock' of assets purchased by the central bank, regardless of the pace at which the central bank accumulates these bonds over time. 'Flow effects', by contrast, emerge at the time when the central bank actually intervenes in the market, with larger interventions on a given day leading to larger effects in the targeted market segments. Our findings support the 'final stocks' view, given that we find large announcement and some pre-announcement expectation effects. 'Flow effects' are transient and confined to the period when markets were operating under acute financial stress. This result broadly consistent with previous findings that emphasise the strength of 'flow effects' in targeted market segments particularly under distressed market conditions (Altavilla et al., 2021).

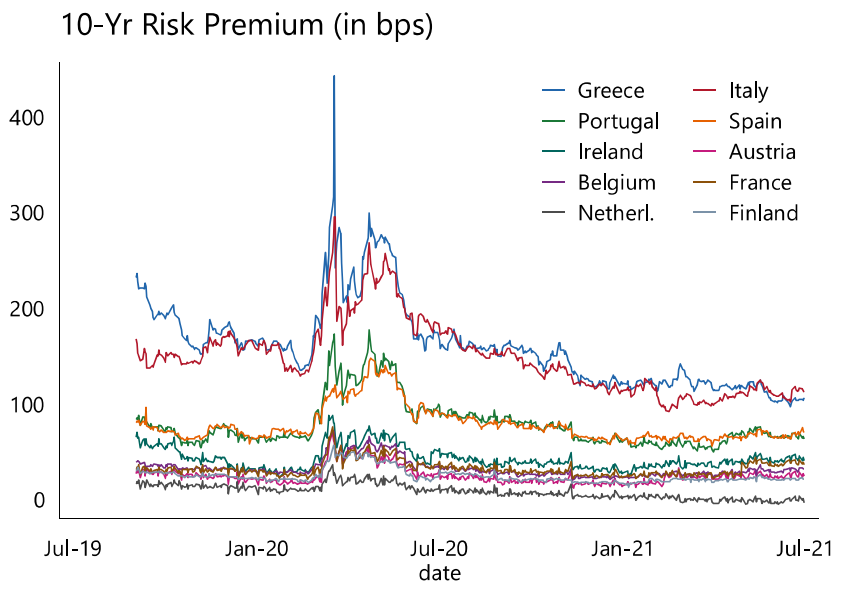
The rest of the paper flows as follows: Section 2 describes the data; Section 3 presents our enhanced event study method; Section 4 discusses the main results, Section 5 examines the robustness of our baseline results by addressing two frequent analytical concerns, and Section 6 concludes.

DATA

We collect data on the sovereign risk premium of ten euro-area countries with the largest GDP after from Germany's: Austria, Belgium, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal, and Spain. Collectively, these issuers accounted for almost 80% percent of the total outstanding marketable sovereign debt in the euro area during the pandemic.

The sovereign risk premium refers to the difference in yield of the 10-year benchmark sovereign bond of the respective country versus Germany. Our sample starts in September 2019 (before the outbreak of the pandemic) and runs until the end of Q2 2021. During that period, the sovereign risk premium of Greece went from 135bps in early 2020 to 443bps in March 2020 and back down to below 100bps by the end of the sample period. Figure 1 shows the time series and Table 1 presents summary statistics.

Figure 1: Risk Premium of Euro Area Countries During the Pandemic



Source: Haver and Bloomberg.

Table 1: Summary Statistics of Sovereign Risk Premia (10-Yr)

Country	Obs	Mean	Std. Dev.	Min	Max
Greece	473	161.0	45.5	97.0	443.0
Italy	473	148.1	37.9	91.6	295.5
Portugal	473	78.7	24.6	50.0	177.0
Spain	473	78.0	18.5	55.7	148.1
Ireland	473	42.7	11.6	23.0	88.0
Austria	473	25.2	9.1	12.0	70.0
Belgium	473	32.5	9.2	20.5	72.0
France	473	32.4	8.0	21.2	76.2
Netherlands	473	8.5	7.4	-5.3	36.0
Finland	473	24.7	7.7	13.0	57.0

Source: Haver Analytics & Bloomberg.

To build our granular country-specific dataset of ECB purchases and market expectations, we combine two main sources of data: the ECB's published data on the evolution of the assets purchased under the PEPP and APP during the pandemic (ECB, 2022) and a survey of market expectations published by Bloomberg ahead of each meeting of the ECB's Governing Council.[1]

We first build an aggregate series of expected and actual asset purchases, which we then break down to the country level, resulting in a granular country-level dataset. We start with three crucial assumptions about structural parameters of the asset purchase programmes:

- *the share of public-debt securities in total purchases*: the ECB announced an explicit share of 80% for the APP but did not communicate about the share for the PEPP. For that reason, we set the share to 80% for the PEPP and the APP (the remaining share comprises corporate bonds and asset-backed securities). We adjust the PEPP's share over time, in line with released information about actual purchases. The APP's share remains constant throughout.
- *the share of supranational debt in public-debt securities*: the ECB announced a share of 10% for the APP but did not communicate about the share for the PEPP. We set the share to 10% of the

[1] Bloomberg has surveyed at least 25 market economists about their expectations for asset purchases ahead of each meeting of the Governing Council. The survey changed over time. During the period with an increasing envelope of the PEPP, the question was "Do you expect the ECB to add an additional envelope to the Asset Purchase Program / to increase the size of the Pandemic Emergency Purchase Program?" Then, from January 2021 onwards, a new question asked: "If you predict the ECB won't use the entire amount, how much do you expect it to spend?" We combine the answers to both questions to construct the "expected final stock" variable. Used with permission of Bloomberg Finance L.P.

public-debt securities for the APP (in line with public announcement) and PEPP. For the PEPP, ex-post data confirmed a target share of 10%.

- *the share of each euro area country in the non-supranational public debt purchases*: we allocate the non-supranational part of public debt purchases according to the ECB's capital key. The capital key is an explicit guidance and constraint in the case of APP, but the PEPP allowed for temporary deviations from the capital key (see Annex). In the case of realized flows, we adjust for deviations based on the bi-monthly breakdown released by the ECB. In the case of expectations, we have no formal basis to predict what temporary deviations had been anticipated by markets, and therefore keep the capital key as a benchmark for the decomposition and assume that the ultimate portfolio purchased under the PEPP would eventually correspond to the capital key. The weights are slightly different under the two programmes, as Greece was excluded from APP but included in PEPP.

Based on these assumptions, we build the following country-specific series:

- *Expected final stock:* the cumulative total amount of net asset purchases under the pandemic-related programmes (i.e. the stock of holdings when the programmes end). We express expectations about the final stock of purchases as a share of outstanding marketable debt. This variable aims to capture the degree of duration extraction, by relating total expected purchases to the amount of outstanding marketable debt (see Eser et al., 2019). The euro amount of expected final stock under the pandemic-related programmes comes from the Bloomberg survey of market economists. We use the simple average of the answers, irrespective of any possible difference in expected end-date of purchases. To construct a daily series between the survey points, we linearly interpolate between observations, but we allow for jumps in expectations in case an envelope announcement occurs between survey points (as it happened in June 2020). As a robustness check, we also compute an expectations series that remains flat until the earlier of a new envelope announcement (which expectations then fully reflect) or the next release of the survey. The country-specific expected stock variables are derived from the aggregate series using the parametric assumptions mentioned above. Data on outstanding marketable debt is from the ECB database.
- *Expected daily purchases (flows).* The daily amount of asset purchases conducted by the ECB under the PEPP and APP. To derive the expected flows at each point in time, we start with the expected aggregate final stock variable, subtract the realised aggregate purchases to date, and

divide the unspent amount by the remaining time until the expected expiry of purchases. The expected expiry of asset purchases is equal to the average answer to the relevant question in the Bloomberg Survey of market economists. We assume a steady pace of purchases from any given moment until expiry and do not account for other factors possibly affecting expectations, such as seasonality or issuance patterns. The ECB stated that country purchases would not permanently deviate from the capital key allocation. For that reason, we use the capital key to calculate each country's share in the remaining aggregate purchases. Our expected flow and expected final stock measures are mutually consistent. ECB guidance regarding the pace of purchases only feed into expected daily purchases through the final expected stock variable. Analogous to the *expected final stock*, we express the country-specific *expected daily purchase* as a share of outstanding marketable debt. We also compute purchases expressed as a share of the 12-month rolling sum of net issuance to control for the possible effect of net flows.

- As a robustness check, we also compute *expected daily purchases* as *'guidance-implied' expectations*, based on the ECB's announcements about the pace of purchases. Between March 2020 and March 2021, we assume that the unspent part of the announced envelope (the publicly announced size of asset purchases, which is different from the forward-looking *expected final stock*) would be spent evenly until the termination of asset purchases. From March 2021 onwards, the ECB provided formal guidance on the purchase pace for the quarter ahead. And from April 2021 onwards, Bloomberg's survey contains information on market expectations.[2] However, as the ECB's public guidance does not necessarily correspond to market expectations for the final stock, the 'guidance-implied' flows can lead to temporary stock-flow inconsistencies.
- *Realised daily purchases (flows)*. Realised purchases are derived from the ECB's monthly APP and bi-monthly PEPP information about country-specific net purchases. We then use the weekly ECB balance sheet data (published each Monday for the end of the previous week) to interpolate between these official data points. We calculate weekly net aggregate purchases as the weekly changes in the aggregate PSPP and PEPP portfolio. We convert aggregate weekly purchases into daily net purchases by dividing through the number of trading days in the week. As a consequence, the aggregate purchase pace changes each week, while country weights are

[2] The exact survey question in April and June is "*The ECB recently stepped up buying under PEPP to about 20 billion euros/week. Until when do you expect this pace to be maintained?*" which is then replaced by "*The ECB has pledged to keep buying bonds under PEPP at an accelerated pace this quarter. How much do you expect the ECB to spend on average in [each month ahead]?*"

adjusted each month for PSPP and every second month for PEPP. As with the *expected daily purchases*, we express the *realised daily purchases* as a share of outstanding marketable debt and as a share of the 12-month rolling sum of net issuance.

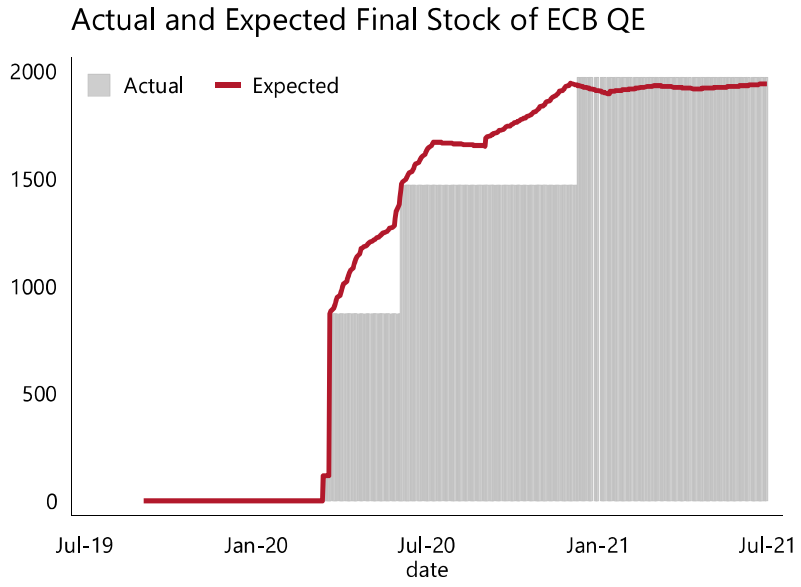
- *Surprise daily purchases* (flows), the difference between expected and realized daily purchases. Surprise daily purchases can be both negative and positive.

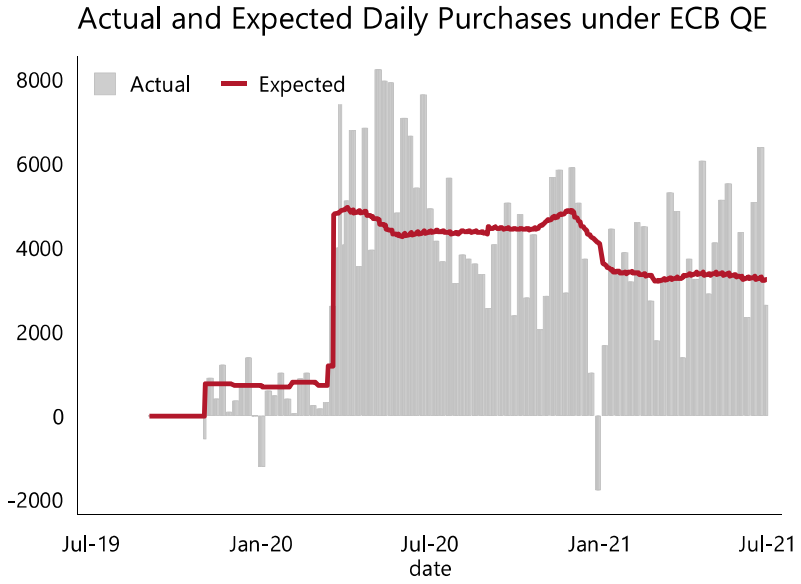
Figures 2 show aggregate actual and expected asset purchases: (i) the total size of the asset purchases until expiry ('the final stock'); and (ii) daily purchases ('the flow'). The country-specific series are in the Annex.

The *announced final stock* increased in three increments: in March 2020 (at inception), in June, and finally in December in the same year. The *expected final stock* started leading in time the public announcements about recalibrations of asset purchases from March 2020. Interestingly, markets did not expect any additional upward recalibration after the December 2020 recalibration, and instead believed that some small part of the overall envelope would not be spent.

Realised daily asset purchases also went through three distinct phases: (i) up to March 2020, the ECB's daily purchases were about €0.5bn; (ii) from March to June, average daily purchases increased to about €6bn; (iii) from July onwards, daily purchases fell back down to about €3.8bn. However, period averages may conceal just as much as they illuminate, given the significant volatility in daily purchases from week to week throughout the sample period.

Figure 2: Actual and Expected Final Stock and Daily Purchases under the ECB's Asset Purchase Programmes During the Pandemic





Note: The charts show the aggregate final stocks and daily purchases (the flow) of the ECB's pandemic-related asset purchase programmes. Stocks and flows are shown as expected and realised. The difference between expected and realised purchases is equal to daily surprise purchases.

Source: Authors' calculation based on ECB, Haver, and Bloomberg Finance L.P. data.

EVENT STUDY AS EMPIRICAL METHOD

Event studies are a powerful and popular empirical method to study the impact of monetary policy announcements on sovereign risk premia (see, for example, Andrade and Ferroni, 2021; Brand et al., 2010; Cieslak and Schrimpf, 2019; Fratzscher et al. 2016; Rostagno et al., 2021; Szczerbowicz, 2015; Urbschat and Watzka, 2020). They identify the effects of asset purchases by focusing on changes in bond yields in narrow time windows. The critical assumption that allows giving a causal interpretation to event studies is that the reaction of bond yields only captures the impact of news released during the event window (Gürkaynak and Wright, 2013).

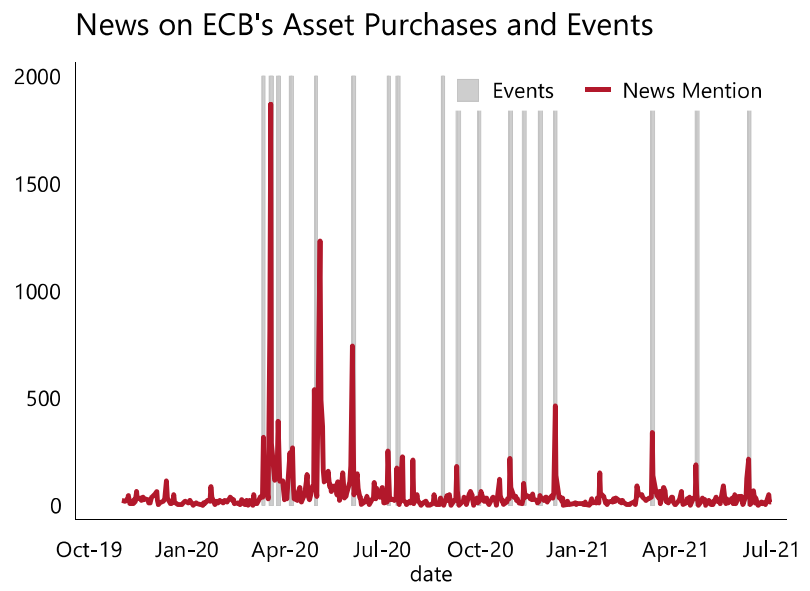
The plausibility of this assumption depends on the length of the event window. We focus on time windows of two days, including the day of the announcement and the subsequent trading day, to allow markets to digest and interpret the new information revealed by the ECB's announcements. Two-day windows are standard in the empirical literature on cross-country effects of monetary policy announcements. The window length balances necessary conditions for identification with less-than-instantaneous price adjustments (see, for example, Krishnamurthy and Vissing-Jorgensen, 2011; Rostagno et al, 2021; and Swanson, 2011). Measuring changes in sovereign risk premia at a higher than daily frequency (see Nakamura and Steinsson, 2018; and Altavilla et al., 2019; for examples) is not straightforward, given limited liquidity in the smaller euro area sovereign bond markets. Our sample period is September 2019 to June 2021.

We identify 18 events when the ECB revealed information about the design and implementation of asset purchase programmes as part of its policy response to the pandemic (see Annex 1 for the full list of events and a brief description of the new information released to the public on each event). Our events fall into two categories: (i) official announcements on asset purchases following the regular meetings of the ECB's Governing Council; (ii) other irregular channels of communication that released important news to the public, such as speeches and blogs by members of the ECB's Executive Board. We rely on ECB records and Bloomberg news reports of these instances to analyse the content and use judgment to select the most important events.

As Rostagno et al. (2021), we cross-check and confirm our event list with an agnostic identification procedure based on media coverage. Using Brandwatch (a major news and consumer research provider), we created an index that measures media mentions of the ECB and asset purchase programmes in major

English-speaking news outlets throughout our sample period.[3] Figure 3 shows that our events coincide with all the local peaks of the news index. The index reaches highs in the second half of March 2020, with a peak in mentions (+1,083%). The period from late-April to mid-May also saw intense media coverage. Media mentions pick up again in the first week of June, before moving lower until the end of sample period, with the exception of a few days in December 2020.

Figure 3: Media mentions of ECB asset purchases and Event Days



Source: Brandwatch and authors' calculations.

[3] Our query searches for mentions of "ECB", "European Central Bank", "Draghi", "Lagarde" in the context of the words "QE", "quantitative easing", "asset purchase", "APP", "PSPP", "PEPP" and "easing". Results should exclude mentions of "Federal Reserve", "Bank of Japan", "Bank of England", "BoJ", "BoE", "Fed", "Japan", "US", "U.S.", and "England". The query focus on English-speaking media in the euro area, the UK, and the US.

Our analysis focuses on risk premia. Risk premia, by definition, capture country-specific factors, whereas common factors for sovereign yields of the euro area as a whole (principally the excepted course of short-term risk-free rates and term premia), do not feature (see Annex).

To explain country-specific risk premia, we estimate the following model separately for each country i using OLS:

$$\Delta rp^i_{t+1;t-1} = \alpha^i + \sum_{j=1}^{18} \beta^i_j D_j + \gamma^i \Delta QEexpc^i_{t+1;t-1} + \delta^i QEflows^i_{t+1;t-1} + \theta^i \Delta i_{t+1;t-1} + \vartheta^i X_t + \varepsilon^i \quad (1)$$

where:

- $\Delta rp^i_{t+1;t-1}$ is the two-day change in sovereign risk premium of country i;
- D_j a dummy variable that takes on the value of 1 on the day of event j, and zero otherwise;
- $\Delta QEexpc^i_{t+1;t-1}$ is a measure of the two-day change in market expectations about the final size of the ECB's purchase of sovereign bonds of country i during the Covid-19 crisis (normalised by the amount of outstanding marketable debt);
- $QEflows^i_{t+1;t-1}$ is a measure of the ECB's two-day purchases of sovereign bonds of country i (normalised by the amount of outstanding marketable debt);
- $\Delta i_{t+1;t-1}$ is the two-day change in the spot 3-month OIS rate and the 3-month OIS forward rate in 12 months;
- X_t is a matrix of control variables, all expressed as two-day changes: the ECB's composite indicator of systemic stress in the euro area (CISS, see Holló et al., 2012), the main euro area stock price index (Eurostoxx), and market-based inflation expectations (the 5-year forward rate of the 5-year inflation-linked swap).

The model explains changes in sovereign risk premia with a series of dummy variables that measure announcements by the ECB about asset purchases and control variables. The $\beta^i_j s$ provide our primary measure of the impact of the ECB's asset purchases on country i's risk premium—it measures the announcement effect. The coefficient γ^i captures the impact of expectations, and δ^i the impact of actual purchases. The model is similar to the one in Rostagno et al. (2021) and Havlik et al. (2022), with the major difference that we control for post-announcement purchases.

Ideally, the dummies $D_j s$ would capture exogenous changes in the ECB's conduct of asset purchases—in Campbell et al.'s terminology (2012), we are interested in an 'Odyssean' policy shock that measures changes in the ECB's intention to deploy asset purchases, independent of the economic prospects of the

euro area. In practice, however, the event dummies contain additional information that could affect country risk premia: (i) policy intentions unrelated to asset purchases, such as changes to the future path of policy rates and bank refinancing operations (Gürkaynak et al., 2005, Altavilla et al., 2019; Swanson, 2020); (ii) the ECB's assessment of the economic outlook, the 'Delphic' component of ECB communication. The non-monetary information shocks in (ii) are likely to play a large role in transmitting monetary policy to the rest of the economy (Jarociński and Karadi, 2020; and Nakamura and Steinsson, 2018).

We address this complication in two ways. By focusing on risk premia, we strip out the component of sovereign yields directly affected by expectations about the future path of risk-free policy rates (see equation (3) in Annex). We also add spot and forward 3-month OIS rates, which depend on expected short-term market rates and as such are particularly sensitive to ECB forward guidance about interest rates (Altavilla et al. 2019). Since market expectations of future short-term rates may also affect risk premia indirectly through other variables, we also add standard controls that capture news about policy commitments unrelated to asset purchases and information effects (Rostagno et al., 2021 and Havlik et al., 2022 also add control variables to isolate the policy component of asset purchases announcements).

Equation (1) pinpoints the moment in time when the ECB's asset purchases can have an impact on sovereign risk premia: (i) *at the time of* announcement; (ii) *before* the announcement; and (iii) in the period *after* the announcement during the actual implementation of purchases. The impact on announcement will be large if markets did not expect the announcement and if the announcement is judged to be credible, all else equal. An impact before the announcement would suggest that markets started to anticipate the actions by ECB at a later stage. An impact after the announcement during the actual implementation phase indicates the presence of frictions in financial markets (including limited credibility) that prevent markets from fully incorporating the information revealed during announcements into sovereign bond prices. The coefficients β^i, γ^i, δ^i measure the respective strength of the impact at these three different moments in time.

Note that this enhanced event study design addresses a common criticism of event studies as an empirical method: event studies can under- or overestimate the total effect of monetary policy actions, depending on (i) the role of pre-announcement expectations; and (ii) the persistence of the announcement effects. Event studies, by definition, measure the price impact in a narrow time window. By comparison, our design enriches the typical event study set-up by also attempting to capture systematic price movements before and after the announcements. That way, our approach seeks to

measure the total effect of asset purchases over the operational cycle (from the moment first rumours are circulating among well-informed market participants, over the moment when these rumours firm up to become the consensus belief in markets, to the moments when the asset purchases are publicly announced and actually implemented).

That said, enhancing the event study design with expected stock and purchase variables raises a new concern. Unobserved factors can move bond yields, such as news about the financial health of the issuer, general risk aversion, changes in investor preferences, the external environment, etc. Within the event window, the probability of systematic co-movements between these unobserved factors and the explanatory variables is small. However, outside the event window, the assumption of expected stock and purchase variables being exogenous to sovereign risk premia is harder to defend. Our estimates of γ^i, δ^i may therefore suffer from bias, of an unobservable sign and magnitude. We are not aware of appropriate instruments that would allow us to strip out any possible endogenous variation in expectations and purchase flows. For now, we assume that the correlation between expectations and daily purchases is not systematically related to unobserved factors over time and across countries.

Another limitation is that we do not have information about which securities the ECB bought on a given day. Security-level information is one way to address the possible endogeneity bias between purchases and risk premia (see De Santis and Holm-Hadulla, 2020; and Altavilla et al., 2021). The weighted-average maturity of the total portfolio of purchased assets stood between 6 to 9 years for the countries in our sample at the end of PEPP net purchases in March 2022. The 10-year sovereign risk premium we use in our study is therefore viewed as a proxy variable and is closely watched by market practitioners.

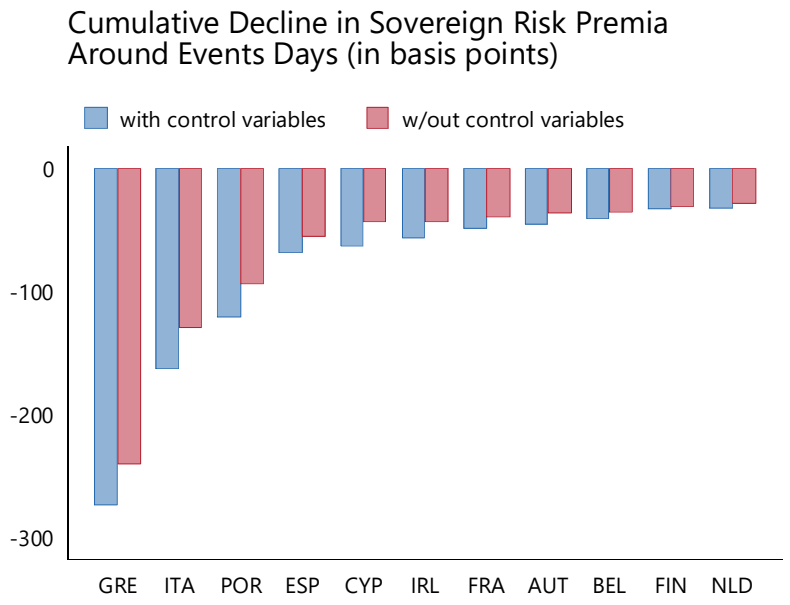
RESULTS

This section presents the main results of our estimations of (1), the enhanced event study. We summarise our main findings as follows: (i) the announcements effects were economically large and the time of announcements was when the bulk of the total effect of asset purchases occurred; (ii) the effects of expectations about the final stock and actual daily purchases depends significantly on the degree of market stress and the country under consideration; (iii) the flow of daily purchases, regardless of whether measured in terms of realised, expected, or surprise purchases, do not explain country risk premia when markets are functioning normally; (iv) announcements and surprise purchases are powerful in distressed market conditions, which suggests a market stabilisation effect of the asset purchases. Let us examine each of these results in more detail.

The effect on sovereign risk premia on announcement days was economically large, with significant cross-country differences. The β_j in (1) measures the impact of ECB asset purchases on country spreads around the days when the ECB publicly released important information about asset purchases (see Annex for the event days and the set of tables showing the regression results by country). Figure 5 shows the sum of the β_j for each country, a simple, but intuitive, measure of the cumulative effects of ECB's asset purchases. By this metric, the ECB's purchases decreased Greece's risk premium between 220bps – 280bps. Italy had the second largest decline of 130bps – 180bps. The decreases experienced by Ireland, Portugal, and Spain, were in a range of 40bps – 100bps.

The estimated impact from the specification without control variables is smaller than the specification with controls. Notably, the short-term market interest rates and the stock market variables exhibit a strong correlation with sovereign risk premia (see country results in Annex). Without control variables, the event dummies pick up a raft of information contained in monetary policy announcements that are not related to ECB asset purchases (see section 3). This information may be about policy signals other than asset purchases and information about the economic outlook. In our sample, these non-asset-purchase related news items on average increased sovereign risk premia, and accounting for them separately increases the negative impact of the asset purchase announcements (the blue bars in Figure 4 are larger in magnitude than the red bars).

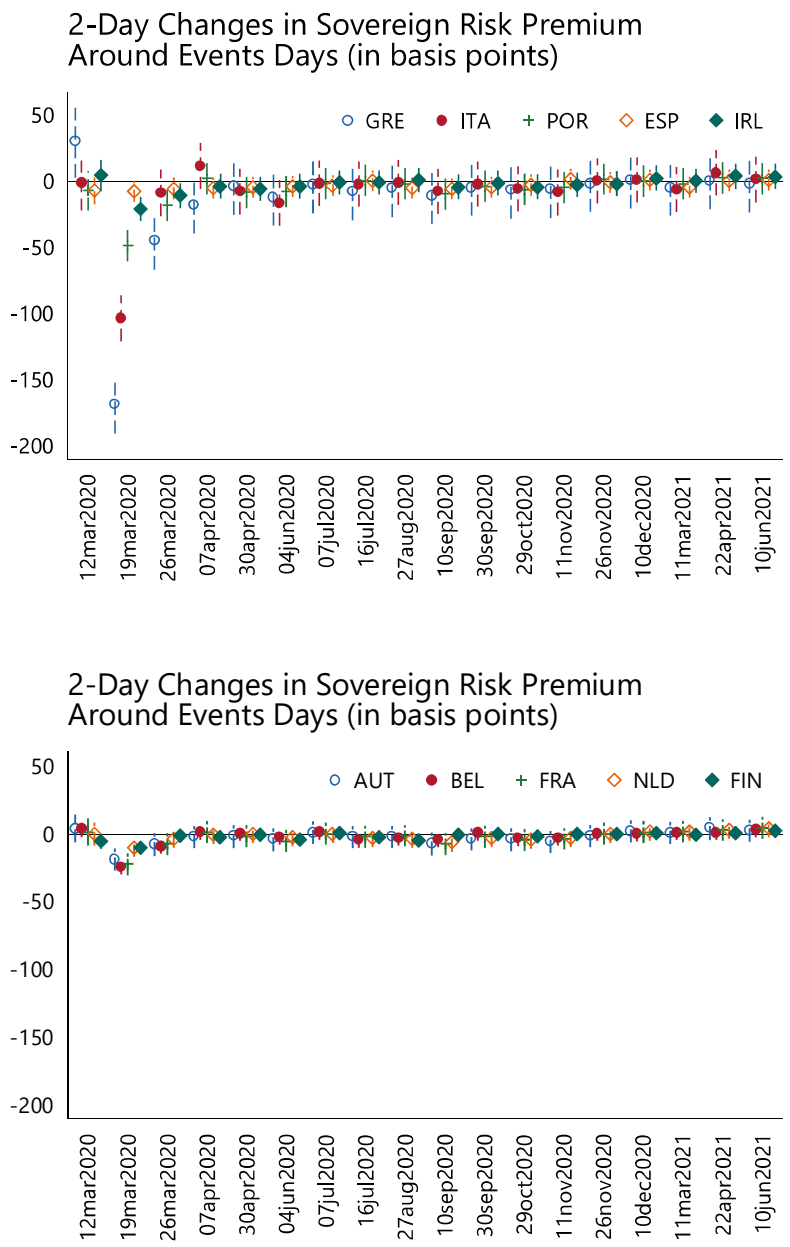
Figure 4: Cumulative impact of ECB asset purchase announcements on 10-year sovereign bond spreads vs Germany



Note: The chart shows the cumulative effect of the asset purchase announcements, measured as $\sum \beta_j$ in (1) for each country i. The estimates are based on two different specifications: with and without the control variables described in the previous section. Detailed country regression results are in the Annex.

The effects were concentrated on event days early-on in the pandemic. Figure 5 shows the estimated β_js, as well as the 95% confidence interval, across all event days for the countries in our sample. Asset purchase announcements had the largest impact in March 2020. For Greece, Italy, and Portugal, more than two thirds of the total cumulative impact occurred on two days: (i) on 19 March, the day after the late-evening announcement of PEPP on Twitter; and (ii) on 26 March, the first day of purchases, following the publication of the formal decision on PEPP in the EU's Official Journal (the decision confirmed the ECB's flexibility of asset purchases around the capital key and issuer limits). By contrast, the estimated impacts from April 2020 are significantly smaller, although the overwhelming number of point estimates remain negative. Statistically speaking, only the events in March are significant at the 95% level of confidence for most countries. The event on 4 June 2020, when the ECB announced the augmentation of the PEPP to €1.35 trillion (see above), borders statistical significance in the case of Italy.

Figure 5: Impact of asset purchase announcements on sovereign bond spreads by event days



Note: The charts show the estimated $\beta_j^i s$ in (1), the coefficient of each of the 18 event dummies. The markers show the point estimates and the dotted lines show the 95% confidence interval. The estimates are from our preferred specification of (1), including the full set of control variables and surprise purchase flows. Tables 1-10 in the Annex present the numeral results.

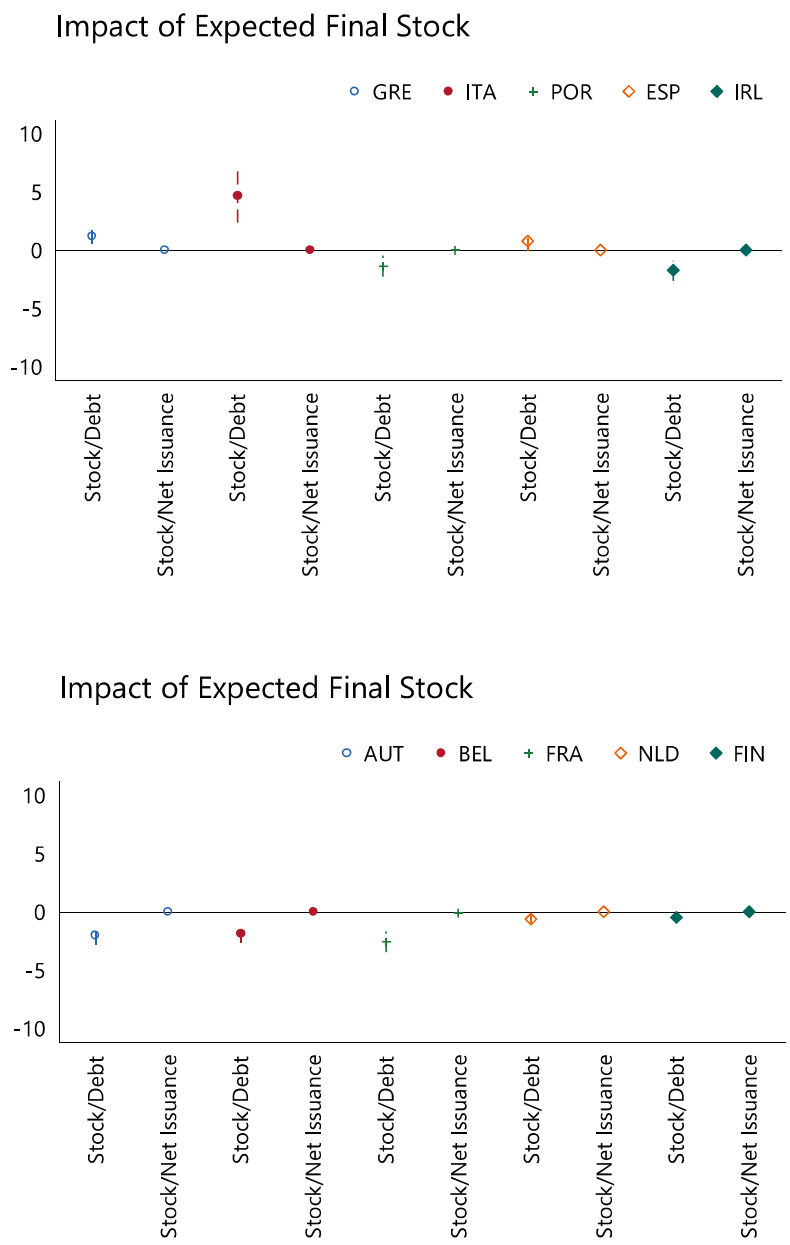
Figure 6 presents the estimated γ^i, the coefficient that measures the role of expectations in affecting sovereign risk premia. We do find significant association, but again with considerable cross-country differences. The estimated γ^i in (1) is positive and significant for Greece, Italy, and Spain, under both measures of market expectations. The positive sign implies that the sovereign risk premium of these three countries widened despite markets expecting future increases in the ECB's asset purchases. The magnitude is economically meaningful: evolving expectations were associated with a widening of about 80bps, 55bps, and 20bps (calculated as $\gamma^i * \sum_t QEexpc_{t+1;t-1}$) in the sovereign risk premium of Greece, Italy, and Spain, respectively.

By contrast, for the higher-rated countries in our sample, the estimated coefficient for expectations is significant and negative. Increasing expectations for the final size of asset purchases compressed the spreads of these countries.

How can we make sense of this cross-country pattern, with a significantly positive association between expectations and spreads in some countries compared with the significantly negative association in other countries? The results in the Annex that re-estimate (1) for the sub-period starting in May 2020 provide a possible explanation. If we exclude the tumultuous weeks of March and April 2020, the significant association between expectations and spreads disappears—both for higher-rated and lower-rated countries.

At the inception of the PEPP, sovereign spreads dropped sharply, but quickly reverted to an upward trend in the following weeks. This dynamic suggests that during the initial turbulent stage of the pandemic, investors may have harboured doubts whether the ECB's policy response would ultimately be powerful enough to contain the fallout from the pandemic. Against the backdrop of large volatility in financial markets, the magnitude of asset purchases mattered for the determination of whether a bad, self-fulfilling equilibrium remained a possibility. The magnitude of asset purchases would cease to have a large impact, once markets expectations converged to the good equilibrium with narrow sovereign spreads.

Figure 6: Impact of expected final stock of asset purchases



Note: The charts show the estimated $\gamma^i s$ in (1), the coefficient of the expected final stock variable. The markers show the point estimates and the dotted lines show the 95% confidence interval. Expectations of the final stock are measured in € billions and in percent of outstanding marketable debt. The estimates are from our preferred specification of (1), including the full set of control variables and surprise purchase flows. Annex Tables 1-10 present the numerical results.

Finally, we examine the role of *daily purchases*. Figure 7 shows that the coefficient δ^i in (1) is not statistically significant in any country, regardless of whether we look at realised, expected or surprise purchases. Normalising purchases by the 12-month rolling sum of net issuance instead of the total outstanding marketable debt, does not change this result either (see Annex for full results). Variations in *daily purchases* ('the flow') do not have explanatory power for the evolution of country risk premia over our entire sample period.

However, the picture changes when we zoom in on the period between early March and mid-April 2020, when markets were operating under severe strain. In that period, the ECB's CISS exceeded by two standard deviations its pre-pandemic average. To account for the significant degree of market stress, we interact the coefficient δ^i with a dummy variable that takes on the value of 1 in the six weeks of acute market stress.

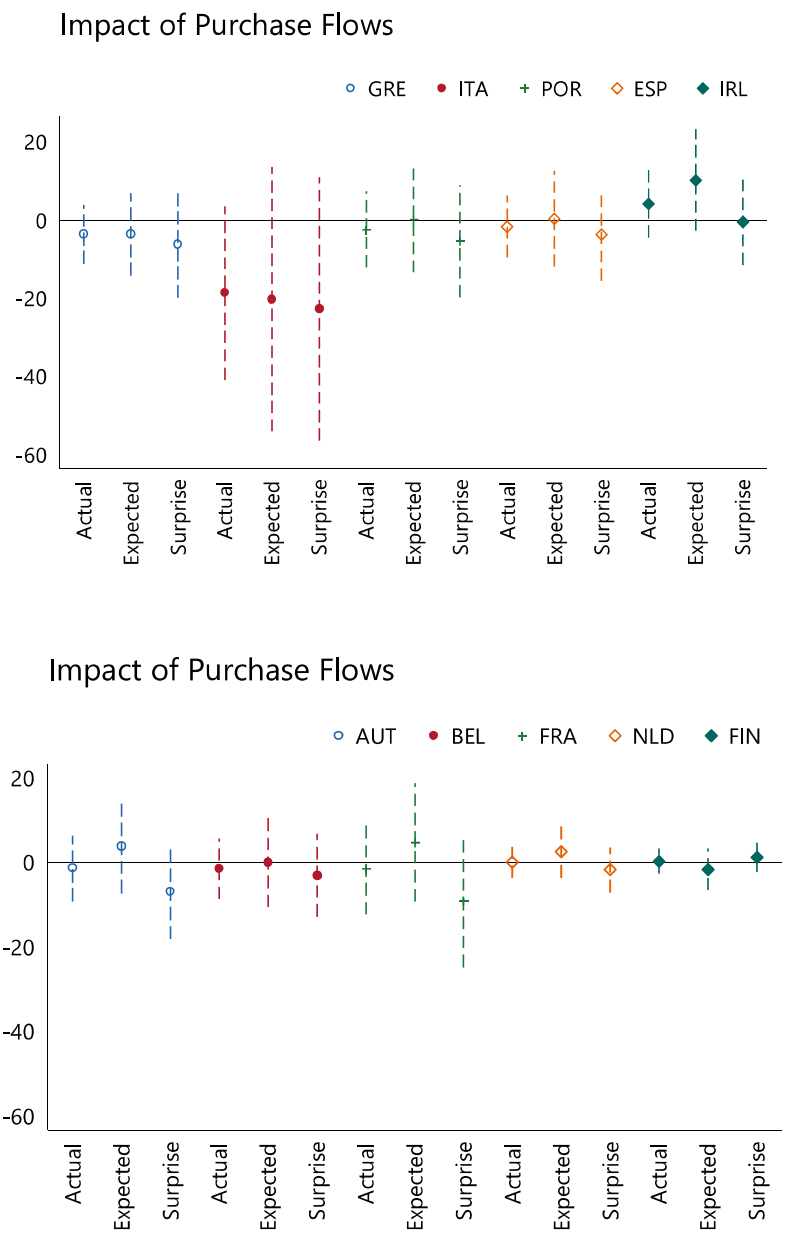
Figure 8 shows the interaction effects, putting into relief a more nuanced interpretation of the role of *surprise* purchases (while actual purchases continued to be insignificant): surprise purchases were generally associated with a compression of spreads, with Greece as the most notable exception. That country is distinct as the ECB was only able to start buying Greek sovereign bonds with a delay, from 26 March 2020, i.e. the day of publication of the legal act of the PEPP. By implication, there were no purchases in the days between the announcement of the PEPP on 19 March 2020 and the legal act, leading to negative surprise purchases in that period. Despite the absence of purchases, Greece's spread declined through March. As both the change in Greece's spread and surprise purchases were negative, the estimated coefficient is positive, reflecting the positive co-movement between surprise purchases and spreads.

The spread-dampening effect of actual purchases in distressed market conditions chimes with empirical results that draw on confidential security level data about ECB purchases (Altavilla et al., 2021; De Santis and Holm-Hadulla, 2020; Schnabel, 2021). The effect is economically large and visible in higher and lower-rated countries. In descending order, Portugal, France, Austria, and Italy saw the largest impact, although Italy's point estimate is not statistically significant. To get a feel for the magnitude, consider that purchases of 0.5 percent of Portugal's marketable debt over and above its share of the overall envelope (PEPP and APP combined) would have brought down Portugal's sovereign risk premium by 130bps (more than half than the peak, Portugal's risk premium reached 180bps). However, Portugal's realised surprise purchases in in the six weeks through mid-April 2020 were negative at -0.4 percent (i.e.

the ECB bought fewer than expected Portuguese bonds). Italy's cumulative surprise purchases were the largest in our sample at +0.5 percent.

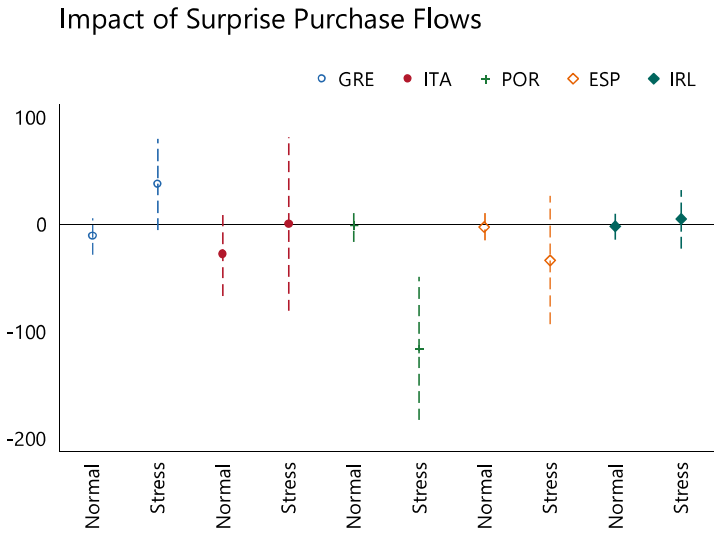
Overall, our results highlight that asset purchases do indeed have a significant effect on sovereign risk premia, but it is crucial to be specific about the point in time, and the reigning market conditions, when this effect occurs.

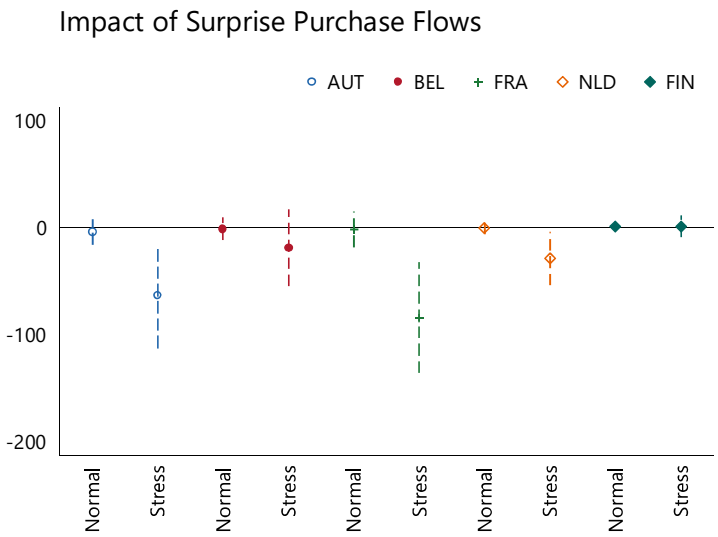
Figure 7: Impact of the flow of purchases



Note: The charts show the estimated $\delta^i s$ in (1), the coefficient of the flow of actual purchases. The markers show the point estimates and the dotted lines show the 95% confidence interval. The flow of purchases is expressed as a share of outstanding marketable debt and measured in three ways: (i) actual purchases; (ii) expected purchases; and (iii) surprise purchases (defined as actual – expected flows). The estimates are from our preferred specification of (1) over the entire sample period, including the full set of control variables and expectations for the final stock. Annex Tables 1-10 present the numerical results.

Figure 8: Impact of the flow of purchases by market conditions





Note: The charts show the estimated $\delta^i s$ in (1), the coefficient of daily purchases interacted with a dummy variable marking the days when the ECB's CISS exceeded by two standard deviations its pre-pandemic average. The markers show the point estimates and the dotted lines show the 95% confidence interval. The flow of purchases is expressed as a share of outstanding marketable debt and measured in three ways: (i) actual purchases; (ii) expected purchases; and (iii) surprise purchases (defined as actual – expected flows). The estimates are from our preferred specification of (1) over the entire sample period, including the full set of control variables and expectations for the final stock. Tables 1-10 in the Annex present the numerical results.

FURTHER ANALYSIS AND ROBUSTNESS

Our enhanced event study specification seeks to capture the impact of ECB asset purchases over the entire operational cycle. But sovereign risk premia react to many different factors, of which we observe

only a subset. This limitation opens up the possibility of bias in our empirical estimates. This section therefore explores two robustness checks of our baseline specification. First, we compute persistence profiles of the announcement effects. Persistence profiles examine systematic patterns in sovereign risk premia in the post-announcement period, which we would expect if 'flow effects' play an important role. Second, we control for supranational fiscal developments during the pandemic, which market observers also point to in explaining the reduction in sovereign spreads during the pandemic.

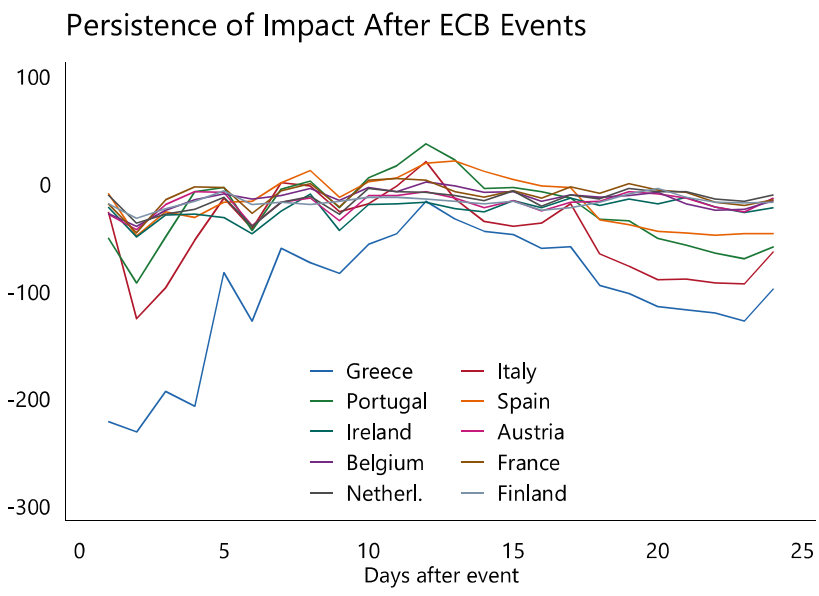
Turning to the of persistence of announcement effects, recall that the coefficient δ^i in equation (1) estimates the effect of the actual asset purchases in the period *after* the announcement. These 'flow effects' tend to be larger if the effects on announcement are transitory or if the announcements are judged to be less than fully credible. That is because actual purchases would then (partly) remedy the reasons that made the announcement effect to be transitory in the first place, such as market frictions or limited credibility of the announcement.

However, our results on the 'flow effects' are subject to the caveat that they may, in part, be due to purchases reacting to changes in sovereign risk (as opposed to causing them). The question of which securities to buy on a given day is not exogenous to the price of the underlying asset, but rather simultaneously determined. For example, the ECB may decide on a given day to disproportionally buy relatively cheap (or expensive) sovereign bonds. This decision could create a positive (inverse) co-movement between purchases and sovereign risk premia, which would manifest itself regardless of the marginal impact of the purchases on prices. Addressing the simultaneity of purchases and prices requires identifying exogenous daily purchases (see De Santis and Holm-Hadulla, 2020 for example using security-level data).

The persistence profiles by Mamaysky (2018) are a non-parametric method that can provide a complementary perspective on 'flow effects'. Essentially, persistence profiles measure the difference in the sovereign risk premium of a given euro area country over time, with the starting point held fixed on the day of an announcement. From the announcement onwards, a time window progressively increases up to either 24 days (a month) or the next announcement day (if two announcements are within 24 days). For every length of the window after the announcement, the persistence profile shows the average change in spreads since the announcement. They therefore measure how far the announcement impact persists into the future. If the announcement effects systematically grow larger in the post-announcement period, it would suggest that post-announcement purchases do have a significant additional effect.

Figure 9 shows the persistence profile for each country and the Annex shows the profile individually together with country-specific bootstrapped confidence bands. A visual inspection of the country profiles suggests two broad categories: (i) profiles that slope upward for the countries with the largest initial impact (Greece, Italy, and Portugal), measured as the difference between the peak impact and the final reading; and (ii) profiles that remain flat for the majority of countries. No country exhibits a clearly downward sloping persistence profile, which would be consistent with significant 'flow effects' materialising in the post-announcement period.

Figure 9: Persistence Profile of Price Impact Upon Announcement



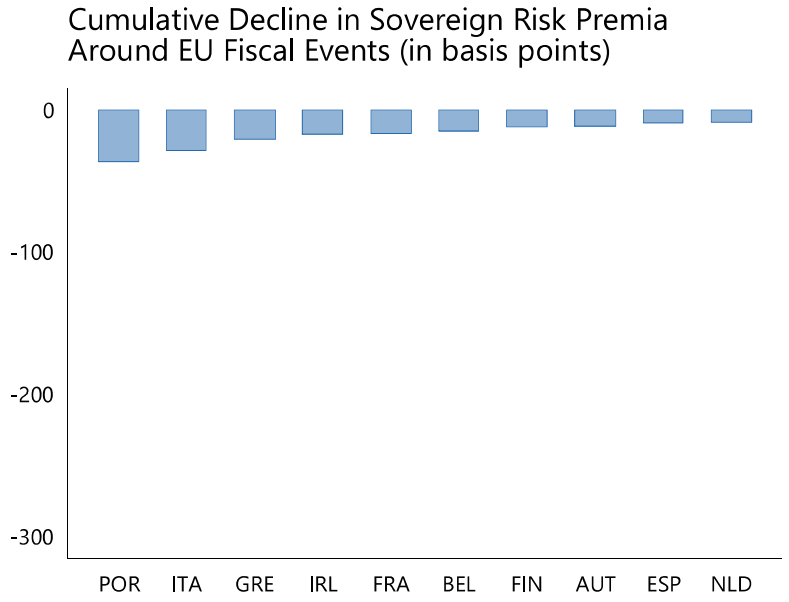
Note: The charts show the cumulative impact on sovereign risk premia in the 25 business days following an event day (days with a significant asset purchase announcement; see Annex for full list). The slope of the persistence profile indicates whether the impact measured the event window changes systematically over time. See Mamaysky (2018).

Second, we address the role of supranational fiscal support that materialised during the pandemic. We add an additional set of event dummies for days when the public learned about the expansion of the EU supranational toolkit (see Annex for an overview of the fiscal events included). Notable innovations during the pandemic include the Next Generation EU fiscal support package and various liquidity support lines (EU's SURE, ESM's pandemic crisis support, EIB). The operational details of these schemes

varied, but they shared the common aspect that they were designed provide fresh liquidity to member states at low (or no) costs—thereby reducing sovereign financing needs.

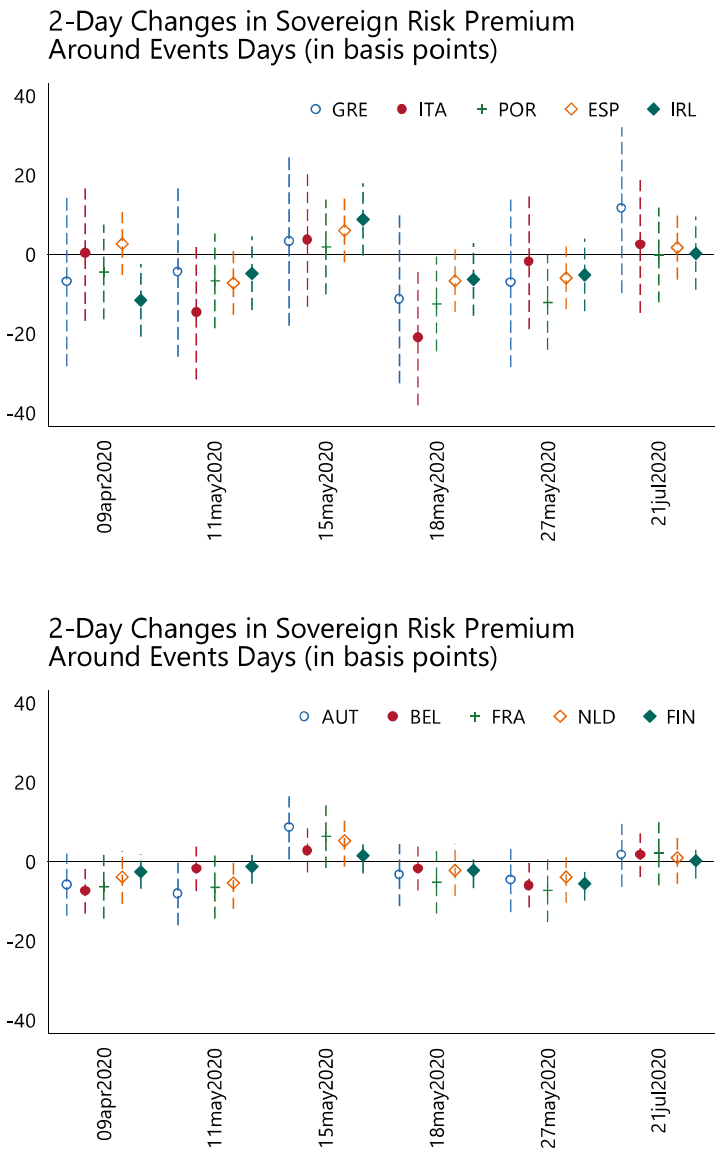
Figure 10 shows the cumulative announcement effect of supranational fiscal policy events and Figure 11 show the country-by-country impact over the event days. Comparing Figure 10 to Figure 4 (the cumulative announcement effect of asset purchases) reveals that the effect of supranational fiscal policy announcement is small. The event-day impacts are mostly insignificant, with the exceptions of Italy and Portugal to the announcement of the Franco-German proposal for a common recovery fund of €500 billion. At face value, these results suggest that supranational fiscal policy did not play a significant role in compressing sovereign risk premia during the pandemic. But two important caveats are in order. First, we have no measure of expectations about supranational fiscal policy support. If markets anticipated that fiscal support would be forthcoming, they may have already reflected this information in sovereign bond prices before the official announcements. Similarly, because of the innovative nature of these support measures, markets may have had a difficult time assessing their impact upon announcements. With time passing, the ultimate impact may have been larger.

Figure 10: Cumulative impact of announcements of EU supranational fiscal policy support measures on 10-year sovereign bond spreads vs Germany



Note: The chart shows the cumulative effect of the announcements of EU supranational fiscal support measures, calculated analogously to cumulative effect of asset purchase announcements in the previous section. Detailed country regression results are in the Annex.

Figure 11: Impact of supranational fiscal policy events



Note: The charts show the estimated vector of ϑ^i in (1) for the subset of control variables that relate to supranational fiscal policy announcement during the pandemic. The markers show the point estimates and the dotted lines show the 95% confidence interval. The estimates are from our preferred specification of (1), including the full set of control variables and surprise purchase flows. The Annex presents the list of fiscal policy events.

INTERPRETATION AND CONCLUSION

Our analysis traces the effects of ECB asset purchases during the pandemic. We differentiate effects due to expectations, announcements, and implementation. We find significant and large effects at the time of announcements, particularly for some of the low-rated countries during the time of market stress. Expectations and implementation effects map, broadly speaking, into 'stock' and 'flow' effects. There are some indications that expectations and implementation also affected spreads, but these effects displayed significant cross-country variation and materialised only in periods when markets were under stress. In an environment of normally functioning markets later in our sample period, these effects were negligible.

The empirical pattern of the announcement effects is particularly interesting. The announcement effects we estimate were large early-on in the pandemic for lower-rated countries—which goes against the idea that announcements tend to be less effective in distressed market conditions (Finlay et al., 2022). Once the market stress passed, announcement effects became negligible and difficult to detect. This pattern is consistent with the existence of multiple equilibria in the market for risky sovereign debt in the euro area. If investors believe that some of the sovereign debt issued by euro area countries is risky due to a non-negative probability of default, they will ask for a larger risk premium to hold that debt. The resulting higher financing costs would deteriorate debt dynamics and remove fiscal space (as a higher share of spending will be allocated to debt service), which in turn would increase the probability of default. Perceptions of risk can thus feed off themselves and trigger self-fulfilling debt crises (see De Grauwe and Ji, 2013, and Blanchard, 2022).

ECB asset purchases effectively eliminated this bad self-fulfilling equilibrium, by ensuring that sovereign risk premia did not enter perception-driven spirals (De Grauwe and Ji, 2022). And specifically, the announcements did most of the work. They had a large impact precisely at the time when investors were most worried about the existence of bad equilibria; once investors convinced themselves that the bad equilibrium had been ruled out, the good equilibrium prevailed. Compared to the trajectory towards the bad equilibrium, the marginal impact of asset purchases on the trajectory towards the good equilibrium then declined (towards zero).

Our findings suggest that the ECB's policy response to the pandemic was highly effective and credible. After some initial speculation about the scope and strength of the policy response, markets concluded that the ECB "[…] will do everything necessary within its mandate" to "ensure that all sectors of the economy can benefit from supportive financing conditions […]" (ECB, 2020c). With the credibility of the

policy response established, subsequent confirmations of the PEPP were sufficient to remain in the new "good equilibrium". The ECB's PEPP helped move the market to an expectations-based equilibrium with lower risk premia, which became stable and reacted very little to 'stocks' and 'flows'—"the credible commitment alone will do the trick" (Wright, 2019). This experience is reminiscent of the OMT, which played a significant role in addressing the sovereign debt crisis in 2012 but was never actually deployed.

Our distinction of expectations, announcements and implementation of asset purchases sits in parallel with another taxonomy for the effects of central bank asset purchases, which focuses on the transmission channels to financial markets: (i) liquidity; (ii) portfolio rebalancing; and (iii) signalling channels. Before concluding, we now offer thoughts about how to reflect on our results from the perspective of transmission channels.

We have emphasised that the asset purchases (announcements, expectations, and implementation) were particularly effective in distressed market conditions—the hallmark of the workings of the 'liquidity channel'. The announcements in distressed markets accounted for at least half and up to 4/5 of the total cumulative impact of all announcements all our sample countries. Similarly, expectation and implementation effects only materialised in the stress period, although with the sign of the effect varying significantly across countries.

At the same time, expectations and announcements are typically related to the portfolio rebalancing channel. The idea behind the portfolio balance channel is that ECB asset purchases are akin to a negative supply shock to the "free-float" of sovereign bonds (Blattner and Joyce, 2020). Forward-looking markets would anticipate future reductions in net supply, bidding up the price of the remaining sovereign securities, first in a narrow maturity bucket but subsequently also across the yield curve (Vayanos and Vila, 2021).

We do find indications of portfolio rebalancing related to the effect of expectations about the final stock on spreads. However, the sign of the effect differed across countries and was specific to the period of market stress. This result raises the question of the direction of causality. Was the rise in expectations too slow to contain spreads, given the economic toll by the pandemic or did markets expect more purchases because spreads were increasing? All that said, our ability to discriminate between liquidity and portfolio balance effects is limited, as the announcement effects that we document could feed into both transmission channels at the same time (Bailey et al., 2020).

Our results say little about the signalling channel, narrowly defined. Under the traditional narrow interpretation of that channel, asset purchases help the ECB to communicate and make credible its

forward guidance about the future path of short-term interest rates, the ECB's main conventional monetary policy instrument. That is because asset purchases act as a commitment device. An increase in interest rates before the end of (net) asset purchases would expose the central bank to potentially significant financial losses. Asset purchases can ensure that the ECB has 'financial skin in the game' to not raise policy rates prematurely. In our sample period, however, the ECB's policy rate guidance remained basically unchanged, as markets expected the policy rate to remain negative for an extended period of time.

More broadly defined, the signalling channel encapsulates the way in which the ECB interprets its mandate and how it intends to react in periods of stress. An example would be a commitment to "save the euro" (see Rogers et al, 2014; Vlieghe, 2018; and Eggertsson et al., 2022 for discussion of the importance of the expectation about the policy rule that the ECB will follow in the future). The ECB's commitment to counter any "sudden divergence in sovereign borrowing costs" signalled new information about the parameters of the ECB's reaction function, particularly in times of market stress (Schnabel, 2021). Accordingly, it would be defensible to group the entire effect of pre-announcement expectations and announcements under the signalling channel, if we interpret this channel more broadly.

As a concluding thought, we stress the link between the credibility of the ECB's commitment to contain financial fragmentation and its overarching price stability mandate. Credibility lies in the eye of the beholder. The ECB's asset purchases as the main instrument of its pandemic policy response were effective because markets judged the ECB to be credible in a low inflation environment. Inflation averaged 0.6% (year-on-year) during our sample period, significantly below the ECB's official target of "close but below 2%". With inflation below target, the ECB enjoyed leeway in translating its commitment to "…do everything necessary within its mandate" into large and flexible asset purchases programmes. However, our results do not address the link between inflation and the effectiveness of asset purchases, nor do we consider possible financial stability ramifications. These aspects are a promising avenue for future research.

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ANNEX

OVERVIEW OF ECB ASSET PURCHASE PROGRAMMES

The PEPP was the latest instalment in a series of purchase programmes conducted by the ECB. In chronological order, the ECB's asset purchase programmes and their main recalibrations were as follows:

> *The Securities Markets Programme (SMP) started in May 2010*. The SMP was the ECB's first purchase programme for public debt securities. The aim was to address market malfunctioning that undermined the monetary policy transmission mechanism (ECB, 2010a). The purchases focused on the public debt of Italy, Spain, Portugal, Greece, and Ireland. The purchases were sterilised to leave the level of central bank liquidity and the stance of monetary policy unaltered (ECB, 2010b). The net purchases ran until early 2012 and the ECB held the purchased securities until maturity without reinvestment. There has been a gradual natural decline in the stock of securities held under SMP as the bonds amortise from a peak of €220 billion in 2012 to €49 billion at end-2019, before the pandemic, which then declined to €6 billion by end-2021.
> *The Asset Purchase Programme (APP) started in January 2015.* It included the public-sector purchases (PSPP; targeting bonds issued by euro area central governments, agencies and European institutions), as well as corporate debt (CSPP), asset-backed securities (ABSPP) and covered bonds (CBPP). The PSPP accounts for about 80% of the APP's total envelope, of which 10% cover securities issued by international organisations and multilateral development banks and the remaining 90% euro-area member states according to the ECB's capital key. The APP "aimed at fulfilling the ECB's price stability mandate" and "address the risks of a too prolonged period of low inflation." (ECB, 2015). Net monthly purchases ran between €60 billion and €80 billion between 2015 and 2017, at €20 billion from late 2019, with a hiatus in net purchases in 2018. The ECB reinvested the principal payments from maturing securities (unlike the holdings under the SMP). Public debt holdings under PSPP reached €2.1 trillion, at end-2019, before the pandemic.
> *The scaled-up APP started on 12 March 2020* as part of the ECB's policy response to the pandemic (ECB, 2020b). The scaled-up APP had a temporary envelope of additional net asset purchases of €120 billion without a pre-set monthly pace of purchases. Instead, the ECB emphasised that the envelope could be spent flexibly through 2020. In total, holdings under PSPP increased to €2.5 trillion by end-2021.
> *The Pandemic Emergency Purchase Programme (PEPP) was announced on the evening of 18 March 2020 (after market close).* The PEPP was meant to "to counter the serious risks to the monetary policy transmission mechanism and the outlook for the euro area posed by the coronavirus" (ECB, 2020c) and push inflation back to "the pre-Covid-19 inflation path" (Lagarde, 2020). Particular threats included the "sudden divergence in sovereign borrowing rates" (Schnabel, 2021) and "non-fundamental volatility in spreads" (Lane, 2020). The PEPP's initial envelope was €750 billion in March 2020, but the ECB subsequently augmented it to €1,350 billion (ECB, 2020d) to finally reach €1,850 billion (ECB, 2020e). The ECB did not pre-announce the final composition of PEPP (see below). Retrospective implementation data reveals that about 97% of purchases involved public-sector securities (higher than the 80% share of the PSPP under APP), and about 9% of these were supranational (similar to the 10% share under the PSPP).

The PEPP was the ECB's main monetary policy instrument to fight the economic fallout from the pandemic. The ECB enjoyed an unprecedented degree of flexibility in the implementation of the asset purchases under the PEPP, setting it apart from previous programmes. Purchases under the PEPP varied

over time, across asset classes and among jurisdictions, under the sole discretion of the ECB. The following parameters were handled more flexibly than previously:

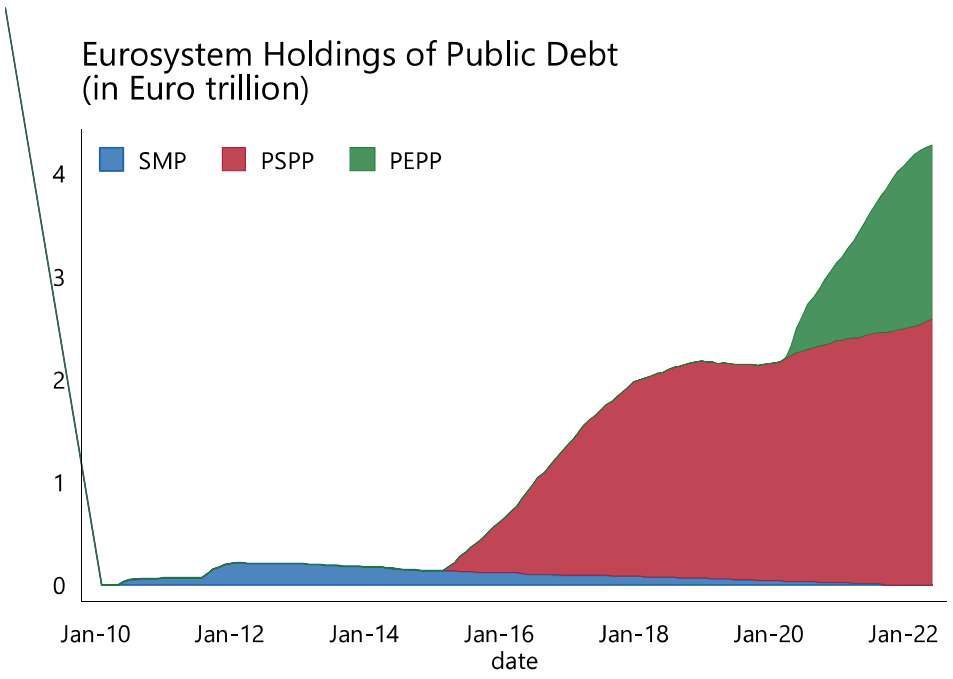
Ratings. The PEPP contained a waiver of the eligibility requirements for securities issued by Greece, which meant that Greek government bonds were included in the universe of eligible jurisdictions despite their sub-investment grade rating.

Purchase pace. The PEPP (and the additional temporary APP envelope) defined an overall envelope and end-date for net-purchases but, at least initially, did not contain a reference to a target monthly pace of purchases. This lack of specificity gave the ECB discretion to adjust purchase volumes flexibly according to market conditions. Particularly the first months of the PEPP after inception were characterised by front-loaded purchases of jurisdictions experiencing diverging financing conditions, whereas the purchases reverted to a steadier pace from the summer of 2020.

Capital key deviations. PEPP purchases allowed for significant deviations from portfolio allocation based strictly on the capital key, which favoured lower-rated members states with higher risk premia in the beginning of the PEPP. Deviations from the capital key declined gradually over time.

Issue/issuer limits. PEPP purchases could go up to 50% of a single security or of the eligible universe of assets by the same issuer (country). Under the APP, the ECB had operated under a self-imposed limit of 33% for issue share and issuer limits. Furthermore, PEPP also allowed for the purchases of shorter maturities.

Chart: Eurosystem holdings of Public Sector Debt by Purchase Programmes



Source: ECB

Table: Overview of Asset Purchase Programmes (Size, Pace, Eligibility, Constraints)

	SMP	APP	PEPP
Dates	May 2010 – Sep 2012	Jan 2015 – Dec 2018 Sep 2019 – Jun 2022	Mar 2020 – Mar 2022
Objective	"address severe tensions in financial markets"	"aimed at fulfilling the ECB's price stability mandate" and "address the risks of a too prolonged period of low inflation."	"to counter the serious risks to the monetary policy transmission mechanism and the outlook for the euro area"
Sovereigns purchased	Greece, Ireland, Italy, Portugal, and Spain	Euro area member states with investment grade rating	All member states
Constraints	No explicit constraint	Capital key allocations; 33% issue and issuer limit	Flexible deviation vs cap. key, up to 50% per issuer
Announced envelope	Not specified	€3440 billion	€1850 billion
Purchase pace	Up to €45 billion/month	€20-80 billion/month	€30-120 billion/month
Accumulated stock	€220 billion	€3440 billion	€1718 billion
Reinvestments	**No**	**Yes**	**Yes**
Sterilization	**Yes**	**No**	**No**

Note: For further details see Annex. Source: ECB.

DEFINITION OF SOVEREIGN RISK PREMIUM

Following Krishnamurthy et al. (2018), the risk premia of country *i* and day *t* can be derived from combining expressions for the sovereign yield of Germany and country i:

$$yield_t^{ger} = \sum_{t=1}^{T} \mathrm{E}(i_t) + term_premium_t^{ger} \quad (1)$$

$$yield_t^i = \sum_{t=1}^{T} \mathrm{E}(i_t) + term_premium_t^{ger} + default_risk_t^i + redenomination_risk_t^i + segmentation_risk_t^i + \varepsilon_t^i \quad (2)$$

$$rp_t^i = yield_t^i - yield_t^{ger} = default_risk_t^i + redenomination_risk_t^i + segmentation_risk_t^i + \varepsilon_t^i \quad (3)$$

EXPECTATIONS OF FINAL STOCK AND ASSET PURCHASE FLOWS BY COUNTRY

Chart: Greece

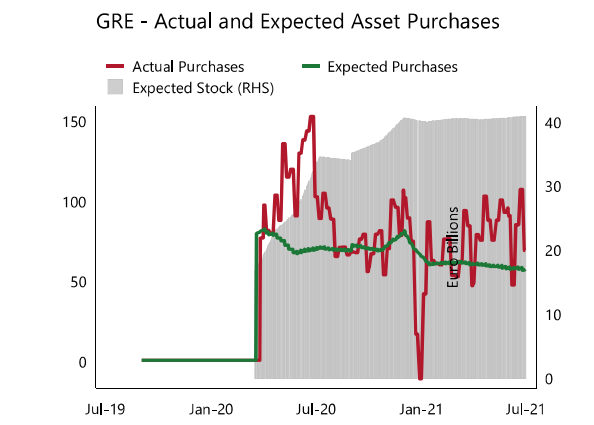


Chart: Portugal

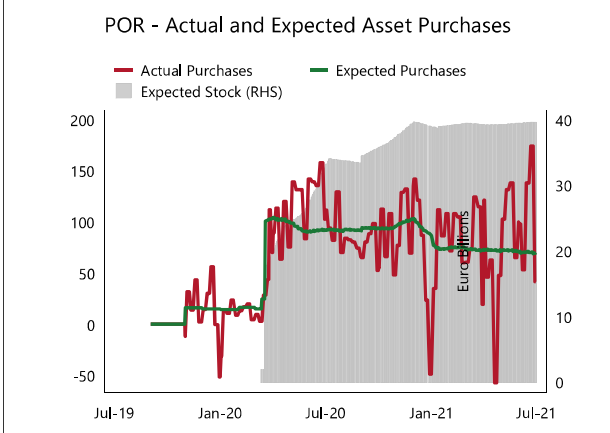


Chart: Ireland

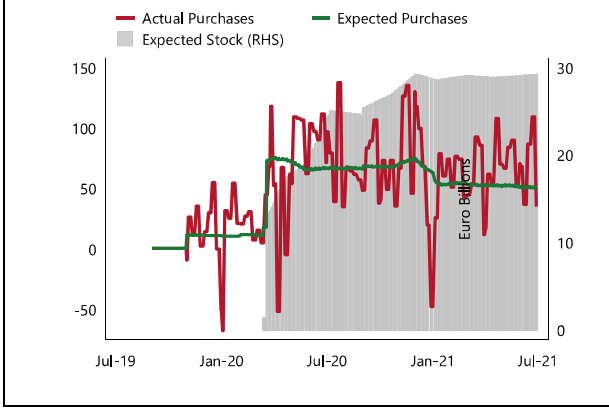
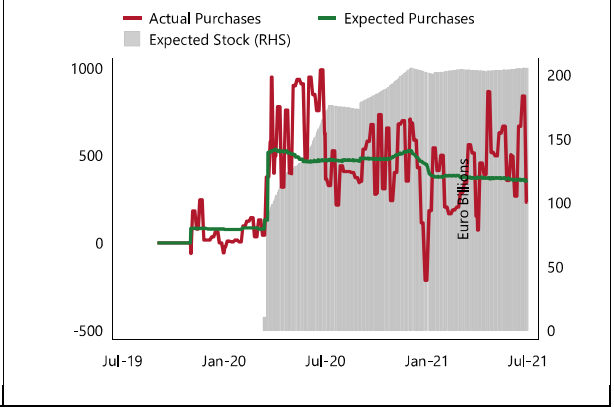


Chart: Spain



Source: Authors' calculations based on Bloomberg Finance L.P.

Chart: Italy

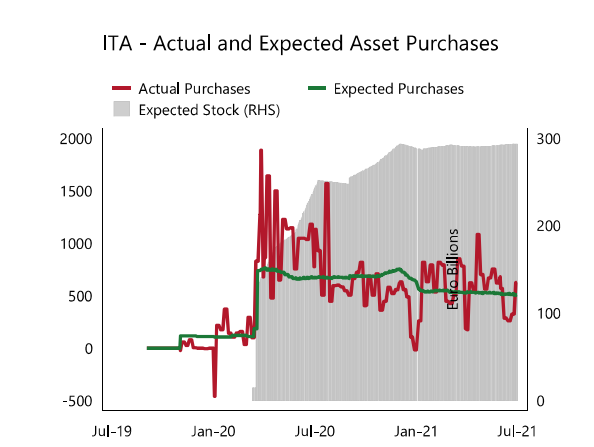


Chart: Austria

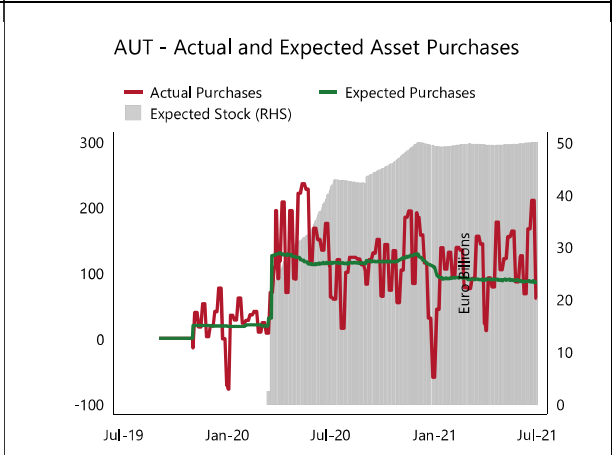


Chart: Belgium

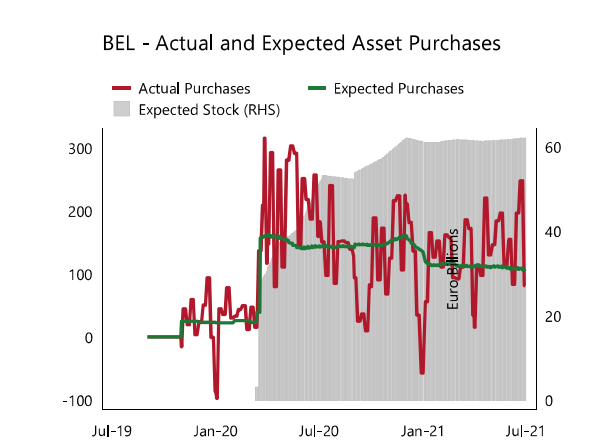
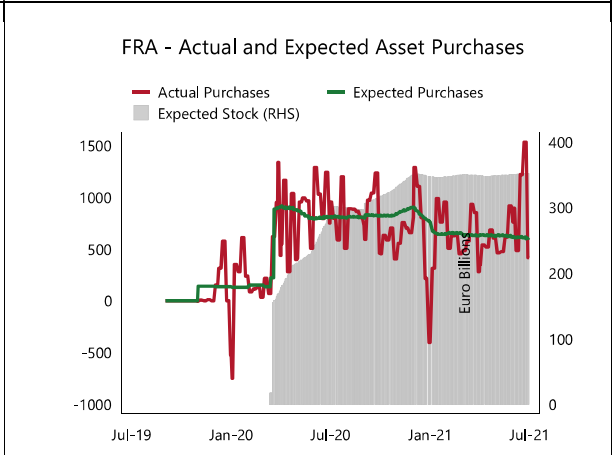
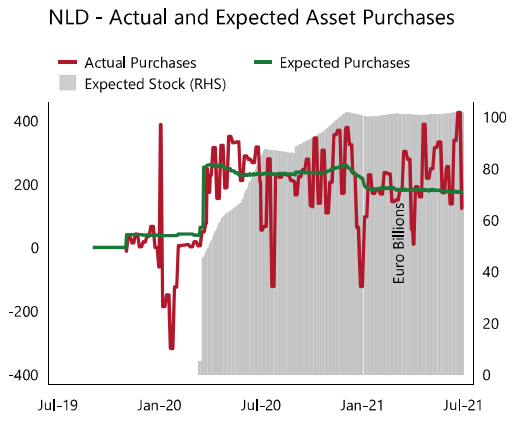
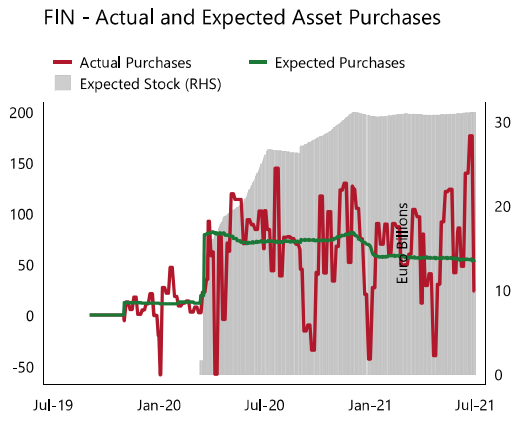


Chart: France



Source: Authors' calculations based on Bloomberg Finance L.P.

Chart: Netherlands	Chart: Finland
	

Source: Authors' calculations based on Bloomberg Finance L.P.

TABLES 1-10: EVENT STUDY RESULTS BY COUNTRY

Finland

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
12mar2020	-0.03	-0.00	-0.07	0.06	0.58	0.10	0.46
	(-0.01)	(-0.00)	(-0.03)	(0.02)	(0.21)	(0.04)	(0.16)
19mar2020	-10.03***	-9.04***	-8.99***	-8.95***	-9.09***	-9.01***	-9.07***
	(-4.16)	(-3.82)	(-3.80)	(-3.78)	(-3.80)	(-3.75)	(-3.85)
26mar2020	-3.03	-2.63	-2.54	-2.65	-3.17	-2.73	-2.73
	(-1.26)	(-1.10)	(-1.07)	(-1.11)	(-1.32)	(-1.14)	(-1.15)
07apr2020	-4.03	-4.03	-3.98	-3.79	-3.73	-3.82	-3.89
	(-1.67)	(-1.71)	(-1.69)	(-1.59)	(-1.55)	(-1.45)	(-1.64)
30apr2020	-1.28	-1.54	-1.46	-1.52	-1.74	-1.47	-1.52
	(-0.53)	(-0.65)	(-0.62)	(-0.64)	(-0.73)	(-0.62)	(-0.65)
04jun2020	-5.03*	-4.76*	-4.68*	-4.78*	-4.86*	-4.51	-4.84*
	(-2.08)	(-2.02)	(-1.99)	(-2.04)	(-2.05)	(-1.90)	(-2.07)
07jul2020	-0.03	-0.44	-0.35	-0.43	-0.43	-0.12	-0.45
	(-0.01)	(-0.19)	(-0.15)	(-0.18)	(-0.18)	(-0.05)	(-0.19)
16jul2020	-3.03	-3.10	-3.04	-3.04	-2.93	-3.07	-3.07
	(-1.26)	(-1.32)	(-1.30)	(-1.30)	(-1.24)	(-1.31)	(-1.32)
27aug2020	-5.03*	-5.48*	-5.40*	-5.46*	-5.46*	-5.50*	-5.50*
	(-2.08)	(-2.33)	(-2.30)	(-2.33)	(-2.31)	(-2.34)	(-2.36)
10sep2020	-0.03	-0.06	-0.02	0.09	0.13	0.15	0.06
	(-0.01)	(-0.02)	(-0.01)	(0.04)	(0.05)	(0.06)	(0.03)
30sep2020	-0.03	-0.26	-0.19	-0.19	-0.23	-0.14	-0.23
	(-0.01)	(-0.11)	(-0.08)	(-0.08)	(-0.10)	(-0.06)	(-0.10)
29oct2020	-2.03	-2.51	-2.43	-2.43	-2.42	-2.35	-2.52
	(-0.84)	(-1.07)	(-1.03)	(-1.03)	(-1.02)	(-1.00)	(-1.08)
11nov2020	0.97	1.00	1.10	0.93	0.86	1.01	0.95
	(0.40)	(0.42)	(0.47)	(0.40)	(0.36)	(0.43)	(0.41)
26nov2020	-1.03	-0.88	-0.81	-0.83	-0.86	-0.76	-0.88
	(-0.43)	(-0.38)	(-0.35)	(-0.35)	(-0.36)	(-0.32)	(-0.38)
10dec2020	0.97	0.70	0.80	0.67	0.74	0.59	0.69
	(0.40)	(0.30)	(0.34)	(0.29)	(0.31)	(0.25)	(0.30)
11mar2021	-1.03	-0.87	-0.87	-0.87	-0.82	-0.93	-0.89
	(-0.43)	(-0.37)	(-0.37)	(-0.37)	(-0.35)	(-0.40)	(-0.38)
22apr2021	-0.03	0.10	0.07	0.25	0.35	0.21	0.18
	(-0.01)	(0.04)	(0.03)	(0.11)	(0.15)	(0.09)	(0.08)
10jun2021	1.97	2.17	2.17	2.18	2.16	2.15	2.13
	(0.82)	(0.93)	(0.93)	(0.93)	(0.91)	(0.91)	(0.92)
Flows (actual)		0.28					
		(0.18)					
Flows (expected)			-1.63				
			(-0.65)				
Flows (surprise)				1.23	1.63		0.98
				(0.68)	(0.90)		(0.54)
Stock/Debt		-0.52**	-0.51**	-0.51**			-0.50**
		(-3.05)	(-3.00)	(-3.00)			(-2.93)
Stock/Net Issuance					-0.00		
					(-0.82)		
ciss		0.00	0.00	0.00	0.00	0.00	0.00
		(1.29)	(1.22)	(1.32)	(1.33)	(1.27)	(1.25)
ois_3m		-35.57*	-34.49	-35.60*	-38.67*	-35.44*	-39.90*
		(-2.00)	(-1.94)	(-2.01)	(-2.17)	(-2.00)	(-2.25)
ois_3m12m		15.13*	14.38	14.75	9.19	14.08	15.20*
		(2.01)	(1.89)	(1.95)	(1.24)	(1.85)	(2.01)
eurostoxx		-0.24***	-0.23***	-0.24***	-0.21**	-0.23***	-0.23***

		(-3.60)	(-3.47)	(-3.54)	(-3.13)	(-3.43)	(-3.40)
infl_5y5y		-1.59	-1.57	-1.60	-1.45	-1.60	-1.49
		(-1.26)	(-1.24)	(-1.26)	(-1.13)	(-1.26)	(-1.19)
Flows (surprise) in normal mkt. cond.						1.24	
						(0.64)	
Flows (surprise) in stressed mkt. cond.						1.22	
						(0.23)	
Stock/debt in normal mkt. cond.						-1.47	
						(-1.26)	
Stock/debt in stressed mkt. cond.						-0.49**	
						(-2.82)	
09apr2020							-3.19
							(-1.34)
11may2020							-1.59
							(-0.68)
15may2020							2.00
							(0.85)
18may2020							-2.57
							(-1.10)
27may2020							-5.82*
							(-2.49)
21jul2020							-1.26
							(-0.54)
Constant	0.03	0.05	0.20	0.07	0.03	0.10	0.09
	(0.24)	(0.28)	(0.87)	(0.60)	(0.26)	(0.84)	(0.83)
Observations	471	471	471	471	471	471	471
R^2	0.070	0.137	0.137	0.138	0.122	0.139	0.158

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

France

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
12mar2020	15.20***	4.07	4.17	4.05	6.15	4.50	4.73
	(3.51)	(0.83)	(0.85)	(0.83)	(1.26)	(0.93)	(0.97)
19mar2020	-24.70***	-21.04***	-21.16***	-21.26***	-21.50***	-23.28***	-21.38***
	(-5.71)	(-5.12)	(-5.15)	(-5.17)	(-5.24)	(-5.63)	(-5.24)
26mar2020	-11.40**	-8.49*	-8.71*	-8.19*	-8.57*	-5.09	-8.27*
	(-2.64)	(-2.04)	(-2.10)	(-1.97)	(-2.07)	(-1.20)	(-2.01)
07apr2020	0.20	0.26	-0.02	0.38	0.16	2.23	0.30
	(0.05)	(0.06)	(-0.00)	(0.09)	(0.04)	(0.54)	(0.07)
30apr2020	-1.58	-1.94	-2.07	-2.29	-7.32	-1.87	-2.28
	(-0.36)	(-0.47)	(-0.50)	(-0.56)	(-1.75)	(-0.46)	(-0.56)
04jun2020	-6.90	-5.97	-6.17	-5.69	-6.12	-6.50	-5.80
	(-1.60)	(-1.46)	(-1.51)	(-1.39)	(-1.50)	(-1.59)	(-1.43)
07jul2020	0.80	-0.59	-0.76	-0.65	-0.81	-1.01	-0.70
	(0.18)	(-0.14)	(-0.19)	(-0.16)	(-0.20)	(-0.25)	(-0.17)
16jul2020	-1.90	-2.54	-2.65	-2.71	-2.49	-2.41	-2.74
	(-0.44)	(-0.62)	(-0.65)	(-0.67)	(-0.61)	(-0.60)	(-0.68)
27aug2020	-1.20	-1.81	-1.95	-1.85	-1.79	-1.73	-1.92
	(-0.28)	(-0.44)	(-0.48)	(-0.45)	(-0.44)	(-0.43)	(-0.48)
10sep2020	-6.90	-7.05	-7.21	-6.97	-6.91	-6.98	-6.93
	(-1.60)	(-1.73)	(-1.77)	(-1.71)	(-1.70)	(-1.73)	(-1.72)
30sep2020	-1.40	-2.12	-2.23	-2.40	-4.10	-2.19	-2.46
	(-0.32)	(-0.52)	(-0.55)	(-0.59)	(-1.00)	(-0.54)	(-0.61)
29oct2020	-4.70	-4.82	-4.94	-5.17	-5.38	-5.16	-5.33
	(-1.09)	(-1.18)	(-1.21)	(-1.26)	(-1.31)	(-1.27)	(-1.31)
11nov2020	-3.40	-3.10	-3.24	-3.20	-3.23	-3.17	-3.18
	(-0.79)	(-0.76)	(-0.79)	(-0.79)	(-0.79)	(-0.78)	(-0.79)
26nov2020	-0.70	-0.24	-0.37	-0.43	-0.51	-0.39	-0.49
	(-0.16)	(-0.06)	(-0.09)	(-0.11)	(-0.12)	(-0.10)	(-0.12)
10dec2020	1.80	1.01	0.81	1.15	1.33	1.21	1.18
	(0.42)	(0.25)	(0.20)	(0.28)	(0.33)	(0.30)	(0.29)
11mar2021	1.70	1.40	1.39	1.38	1.59	1.61	1.36
	(0.39)	(0.34)	(0.34)	(0.34)	(0.39)	(0.40)	(0.34)
22apr2021	2.50	2.50	2.49	2.55	2.63	2.62	2.51
	(0.58)	(0.62)	(0.61)	(0.63)	(0.65)	(0.65)	(0.62)
10jun2021	3.50	4.27	4.29	4.20	4.21	4.33	4.14
	(0.81)	(1.05)	(1.05)	(1.03)	(1.04)	(1.07)	(1.03)
Flows (actual)		-1.45					
		(-0.26)					
Flows (expected)			4.77				
			(0.67)				
Flows (surprise)				-9.05	-7.30		-9.37
				(-1.13)	(-0.91)		(-1.17)
Stock/Debt		-2.55***	-2.58***	-2.54***			-2.50***
		(-5.47)	(-5.55)	(-5.47)			(-5.44)
Stock/Net Issuance					-0.07***		
					(-5.53)		
ciss		0.00	0.00	0.00	0.00	0.00	0.00
		(0.09)	(0.15)	(0.13)	(0.26)	(0.22)	(0.08)
ois_3m		17.71	15.97	15.32	-4.25	0.81	5.78
		(0.58)	(0.52)	(0.50)	(-0.14)	(0.03)	(0.19)
ois_3m12m		41.64**	43.14**	42.97**	42.53**	45.95***	44.98***
		(3.17)	(3.26)	(3.28)	(3.25)	(3.51)	(3.43)
eurostoxx		-0.72***	-0.73***	-0.73***	-0.68***	-0.70***	-0.72***
		(-6.22)	(-6.30)	(-6.30)	(-5.92)	(-6.08)	(-6.23)

infl_5y5y		-1.54	-1.59	-1.52	-1.55	-1.37	-1.39
		(-0.70)	(-0.72)	(-0.69)	(-0.70)	(-0.63)	(-0.64)
Flows (surprise) in normal mkt. cond.						-1.82	
						(-0.22)	
Flows (surprise) in stressed mkt. cond.						-83.97**	
						(-3.20)	
Stock/debt in normal mkt. cond.						-0.11	
						(-0.03)	
Stock/debt in stressed mkt. cond.						-2.34***	
						(-4.97)	
09apr2020							-6.35
							(-1.56)
11may2020							-6.38
							(-1.58)
15may2020							7.09
							(1.75)
18may2020							-4.99
							(-1.23)
27may2020							-7.62
							(-1.88)
21jul2020							1.75
							(0.43)
Constant	0.10	0.34	0.04	0.26	0.17	0.16	0.29
	(0.51)	(1.02)	(0.09)	(1.34)	(0.88)	(0.77)	(1.51)
Observations	471	471	471	471	471	471	471
R^2	0.118	0.232	0.233	0.234	0.236	0.250	0.257

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Netherlands

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
12mar2020	7.12*	0.98	1.05	0.97	2.40	0.62	1.34
	(2.07)	(0.24)	(0.26)	(0.24)	(0.59)	(0.15)	(0.33)
19mar2020	-11.48***	-9.65**	-9.79**	-9.88**	-10.06**	-13.22***	-9.88**
	(-3.33)	(-2.85)	(-2.89)	(-2.90)	(-2.95)	(-3.55)	(-2.91)
26mar2020	-6.28	-3.91	-4.05	-3.89	-4.31	-4.00	-3.94
	(-1.82)	(-1.15)	(-1.19)	(-1.14)	(-1.26)	(-1.17)	(-1.16)
07apr2020	-0.58	-1.04	-1.24	-0.97	-1.12	0.13	-1.03
	(-0.17)	(-0.31)	(-0.37)	(-0.29)	(-0.33)	(0.04)	(-0.31)
30apr2020	-1.03	-0.36	-0.50	-0.39	-0.45	-0.42	-0.39
	(-0.30)	(-0.11)	(-0.15)	(-0.12)	(-0.13)	(-0.12)	(-0.12)
04jun2020	-2.58	-2.73	-2.83	-2.67	-2.85	-3.00	-2.73
	(-0.75)	(-0.81)	(-0.84)	(-0.79)	(-0.85)	(-0.89)	(-0.82)
07jul2020	0.92	-0.16	-0.29	-0.32	-0.34	-0.61	-0.34
	(0.27)	(-0.05)	(-0.09)	(-0.09)	(-0.10)	(-0.18)	(-0.10)
16jul2020	-2.88	-3.25	-3.35	-3.19	-3.08	-3.11	-3.22
	(-0.84)	(-0.97)	(-1.00)	(-0.95)	(-0.91)	(-0.93)	(-0.96)
27aug2020	-3.68	-3.90	-4.00	-3.90	-3.90	-3.84	-3.95
	(-1.07)	(-1.16)	(-1.19)	(-1.16)	(-1.16)	(-1.15)	(-1.18)
10sep2020	-6.48	-6.28	-6.38	-6.27	-6.20	-6.25	-6.25
	(-1.88)	(-1.87)	(-1.90)	(-1.87)	(-1.84)	(-1.87)	(-1.87)
30sep2020	-2.38	-2.89	-3.00	-2.98	-2.92	-2.96	-3.00
	(-0.69)	(-0.86)	(-0.90)	(-0.89)	(-0.87)	(-0.89)	(-0.90)
29oct2020	-3.88	-4.29	-4.42	-4.42	-4.56	-4.51	-4.50
	(-1.13)	(-1.27)	(-1.31)	(-1.31)	(-1.35)	(-1.34)	(-1.34)
11nov2020	-3.48	-3.09	-3.21	-2.96	-2.98	-3.09	-2.95
	(-1.01)	(-0.92)	(-0.95)	(-0.88)	(-0.88)	(-0.92)	(-0.88)
26nov2020	-0.78	-0.48	-0.61	-0.55	-0.61	-0.60	-0.57
	(-0.23)	(-0.14)	(-0.18)	(-0.16)	(-0.18)	(-0.18)	(-0.17)
10dec2020	1.52	1.24	1.12	1.34	1.49	1.41	1.34
	(0.44)	(0.37)	(0.33)	(0.40)	(0.44)	(0.42)	(0.40)
11mar2021	1.82	1.82	1.80	1.83	1.93	1.94	1.81
	(0.53)	(0.54)	(0.54)	(0.54)	(0.57)	(0.58)	(0.54)
22apr2021	2.12	2.19	2.19	2.41	2.44	2.38	2.37
	(0.62)	(0.65)	(0.65)	(0.72)	(0.72)	(0.71)	(0.71)
10jun2021	3.42	3.96	3.96	3.93	3.92	4.05	3.91
	(0.99)	(1.18)	(1.18)	(1.17)	(1.17)	(1.21)	(1.17)
Flows (actual)		0.07					
		(0.04)					
Flows (expected)			2.60				
			(0.83)				
Flows (surprise)				-1.76	-1.49		-1.58
				(-0.65)	(-0.55)		(-0.58)
Stock/Debt		-0.57**	-0.58**	-0.58**			-0.57**
		(-2.90)	(-2.96)	(-2.93)			(-2.90)
Stock/Net Issuance					-0.00*		
					(-2.35)		
ciss		0.00	0.00	0.00	0.00	0.00	0.00
		(0.37)	(0.43)	(0.37)	(0.35)	(0.34)	(0.31)
ois_3m		-16.24	-17.91	-17.09	-31.14	-23.17	-23.27
		(-0.64)	(-0.70)	(-0.67)	(-1.21)	(-0.91)	(-0.91)
ois_3m12m		45.02***	46.33***	45.54***	43.54***	46.84***	46.99***
		(4.17)	(4.25)	(4.21)	(4.03)	(4.32)	(4.32)
eurostoxx		-0.38***	-0.39***	-0.38***	-0.35***	-0.41***	-0.38***
		(-3.99)	(-4.09)	(-4.00)	(-3.69)	(-4.26)	(-4.02)
infl_5y5y		0.12	0.09	0.15	0.25	0.20	0.21

		(0.07)	(0.05)	(0.08)	(0.14)	(0.11)	(0.12)
Flows (surprise) in normal mkt. cond.						-0.67	
						(-0.25)	
Flows (surprise) in stressed mkt. cond.						-28.99*	
						(-2.29)	
Stock/debt in normal mkt. cond.						0.56	
						(0.36)	
Stock/debt in stressed mkt. cond.						-0.69***	
						(-3.41)	
09apr2020							-3.92
							(-1.17)
11may2020							-5.22
							(-1.56)
15may2020							5.68
							(1.69)
18may2020							-1.92
							(-0.57)
27may2020							-3.84
							(-1.15)
21jul2020							0.53
							(0.16)
Constant	-0.02	0.01	-0.22	0.01	-0.06	-0.07	0.03
	(-0.11)	(0.05)	(-0.67)	(0.05)	(-0.35)	(-0.43)	(0.16)
Observations	471	471	471	471	471	471	471
R^2	0.061	0.125	0.126	0.126	0.120	0.136	0.142

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Austria

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
12mar2020	18.94***	9.18	9.29	9.17	12.06*	9.30	9.65*
	(4.43)	(1.88)	(1.91)	(1.88)	(2.47)	(1.92)	(2.00)
19mar2020	-20.06***	-16.87***	-16.97***	-17.23***	-17.61***	-19.97***	-17.21***
	(-4.69)	(-4.13)	(-4.15)	(-4.21)	(-4.28)	(-4.71)	(-4.24)
26mar2020	-12.06**	-8.75*	-8.99*	-8.51*	-9.11*	-5.56	-8.62*
	(-2.82)	(-2.12)	(-2.18)	(-2.06)	(-2.20)	(-1.30)	(-2.11)
07apr2020	-3.06	-3.20	-3.53	-2.97	-3.28	0.71	-3.08
	(-0.72)	(-0.79)	(-0.87)	(-0.73)	(-0.80)	(0.16)	(-0.76)
30apr2020	-2.31	-2.08	-2.22	-2.28	-4.99	-2.17	-2.27
	(-0.54)	(-0.51)	(-0.54)	(-0.56)	(-1.21)	(-0.53)	(-0.56)
04jun2020	-5.06	-4.53	-4.72	-4.41	-4.88	-4.62	-4.51
	(-1.18)	(-1.11)	(-1.16)	(-1.09)	(-1.20)	(-1.13)	(-1.12)
07jul2020	1.94	0.49	0.37	0.15	-0.04	0.32	0.12
	(0.45)	(0.12)	(0.09)	(0.04)	(-0.01)	(0.08)	(0.03)
16jul2020	-2.06	-2.61	-2.75	-2.68	-2.47	-2.62	-2.70
	(-0.48)	(-0.64)	(-0.68)	(-0.66)	(-0.61)	(-0.65)	(-0.67)
27aug2020	-2.06	-2.54	-2.70	-2.64	-2.65	-2.62	-2.72
	(-0.48)	(-0.63)	(-0.66)	(-0.65)	(-0.65)	(-0.65)	(-0.68)
10sep2020	-6.06	-5.93	-6.10	-5.99	-5.87	-5.94	-5.94
	(-1.42)	(-1.46)	(-1.50)	(-1.48)	(-1.44)	(-1.47)	(-1.48)
30sep2020	-3.06	-3.80	-3.92	-4.12	-5.39	-3.95	-4.14
	(-0.72)	(-0.94)	(-0.97)	(-1.02)	(-1.32)	(-0.98)	(-1.03)
29oct2020	-4.06	-4.48	-4.60	-4.87	-5.19	-4.76	-4.98
	(-0.95)	(-1.10)	(-1.13)	(-1.20)	(-1.27)	(-1.17)	(-1.23)
11nov2020	-5.06	-4.54	-4.78	-4.36	-4.31	-4.48	-4.34
	(-1.18)	(-1.12)	(-1.18)	(-1.07)	(-1.06)	(-1.11)	(-1.08)
26nov2020	-2.06	-1.67	-1.80	-1.95	-2.03	-1.85	-1.96
	(-0.48)	(-0.41)	(-0.44)	(-0.48)	(-0.50)	(-0.46)	(-0.49)
10dec2020	2.94	2.30	2.09	2.38	2.76	2.39	2.38
	(0.69)	(0.57)	(0.51)	(0.59)	(0.68)	(0.59)	(0.59)
11mar2021	0.94	0.71	0.71	0.67	0.94	0.74	0.65
	(0.22)	(0.18)	(0.18)	(0.17)	(0.23)	(0.18)	(0.16)
22apr2021	3.94	3.97	3.89	4.26	4.38	4.11	4.20
	(0.92)	(0.98)	(0.96)	(1.05)	(1.07)	(1.02)	(1.04)
10jun2021	1.94	2.64	2.68	2.52	2.52	2.56	2.50
	(0.45)	(0.65)	(0.66)	(0.62)	(0.62)	(0.63)	(0.62)
Flows (actual)		-1.35					
		(-0.34)					
Flows (expected)			3.97				
			(0.71)				
Flows (surprise)				-6.85	-6.56		-6.26
				(-1.21)	(-1.15)		(-1.09)
Stock/Debt		-1.99***	-2.02***	-2.00***			-1.98***
		(-5.33)	(-5.40)	(-5.36)			(-5.36)
Stock/Net Issuance					-0.01***		
					(-4.87)		
ciss		-0.00	0.00	-0.00	-0.00	-0.00	-0.00
		(-0.05)	(0.03)	(-0.07)	(-0.04)	(-0.04)	(-0.15)
ois_3m		-1.97	-3.76	-4.30	-33.99	-11.49	-13.32
		(-0.06)	(-0.12)	(-0.14)	(-1.10)	(-0.37)	(-0.44)
ois_3m12m		52.25***	53.83***	53.59***	52.58***	52.56***	55.75***
		(4.01)	(4.09)	(4.11)	(4.00)	(4.02)	(4.28)
eurostoxx		-0.65***	-0.66***	-0.65***	-0.59***	-0.62***	-0.66***
		(-5.61)	(-5.73)	(-5.67)	(-5.14)	(-5.43)	(-5.77)
infl_5y5y		-1.39	-1.44	-1.38	-1.25	-1.24	-1.30

		(-0.63)	(-0.66)	(-0.63)	(-0.57)	(-0.57)	(-0.60)
Flows (surprise) in normal mkt. cond.						-3.65	
						(-0.63)	
Flows (surprise) in stressed mkt. cond.						-63.62**	
						(-2.61)	
Stock/debt in normal mkt. cond.						-1.70	
						(-0.66)	
Stock/debt in stressed mkt. cond.						-1.88***	
						(-4.96)	
09apr2020							-5.95
							(-1.47)
11may2020							-7.72
							(-1.91)
15may2020							9.95*
							(2.45)
18may2020							-2.80
							(-0.69)
27may2020							-4.85
							(-1.21)
21jul2020							0.02
							(0.01)
Constant	0.06	0.29	-0.04	0.26	0.12	0.22	0.28
	(0.32)	(0.89)	(-0.10)	(1.30)	(0.61)	(1.05)	(1.40)
Observations	471	471	471	471	471	471	471
R^2	0.115	0.221	0.222	0.223	0.215	0.233	0.247

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Belgium

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
12mar2020	11.96***	9.32**	9.33**	9.35**	10.38**	9.49**	9.94**
	(3.86)	(2.64)	(2.64)	(2.65)	(2.89)	(2.69)	(2.84)
19mar2020	-25.04***	-23.14***	-23.14***	-23.20***	-23.60***	-23.51***	-23.29***
	(-8.09)	(-7.82)	(-7.81)	(-7.84)	(-7.81)	(-7.90)	(-7.94)
26mar2020	-10.04**	-9.79**	-9.93***	-9.72**	-10.58***	-8.64**	-9.97***
	(-3.25)	(-3.26)	(-3.33)	(-3.23)	(-3.45)	(-2.65)	(-3.35)
07apr2020	-0.04	0.53	0.39	0.55	0.56	1.53	0.45
	(-0.01)	(0.18)	(0.13)	(0.19)	(0.19)	(0.49)	(0.16)
30apr2020	1.21	-0.01	-0.02	-0.08	-0.62	0.02	-0.10
	(0.39)	(-0.00)	(-0.01)	(-0.03)	(-0.21)	(0.01)	(-0.04)
04jun2020	-4.04	-2.90	-3.00	-2.88	-2.96	-2.69	-2.99
	(-1.31)	(-0.99)	(-1.02)	(-0.98)	(-0.98)	(-0.90)	(-1.02)
07jul2020	0.96	0.68	0.65	0.64	0.63	1.00	0.64
	(0.31)	(0.23)	(0.22)	(0.22)	(0.21)	(0.34)	(0.22)
16jul2020	-5.04	-5.24	-5.24	-5.32	-5.21	-5.31	-5.30
	(-1.63)	(-1.79)	(-1.79)	(-1.81)	(-1.74)	(-1.81)	(-1.83)
27aug2020	-3.04	-3.67	-3.69	-3.72	-3.73	-3.75	-3.76
	(-0.98)	(-1.25)	(-1.26)	(-1.27)	(-1.25)	(-1.28)	(-1.29)
10sep2020	-3.04	-3.51	-3.46	-3.63	-3.78	-3.46	-3.56
	(-0.98)	(-1.19)	(-1.18)	(-1.23)	(-1.26)	(-1.17)	(-1.22)
30sep2020	0.96	0.70	0.71	0.60	0.27	0.73	0.63
	(0.31)	(0.24)	(0.24)	(0.21)	(0.09)	(0.25)	(0.22)
29oct2020	-4.04	-4.11	-4.08	-4.22	-4.36	-4.06	-4.25
	(-1.31)	(-1.40)	(-1.39)	(-1.43)	(-1.45)	(-1.37)	(-1.46)
11nov2020	-2.04	-2.11	-2.19	-2.11	-2.20	-2.07	-2.15
	(-0.66)	(-0.72)	(-0.75)	(-0.72)	(-0.73)	(-0.71)	(-0.74)
26nov2020	-0.04	0.12	0.13	0.03	-0.15	0.16	0.02
	(-0.01)	(0.04)	(0.04)	(0.01)	(-0.05)	(0.06)	(0.01)
10dec2020	0.96	0.38	0.32	0.36	0.53	0.28	0.36
	(0.31)	(0.13)	(0.11)	(0.12)	(0.18)	(0.10)	(0.12)
11mar2021	0.96	0.83	0.84	0.82	0.90	0.76	0.80
	(0.31)	(0.28)	(0.29)	(0.28)	(0.30)	(0.26)	(0.28)
22apr2021	0.96	1.03	0.96	1.08	1.21	0.96	1.00
	(0.31)	(0.35)	(0.33)	(0.37)	(0.40)	(0.33)	(0.34)
10jun2021	2.96	3.17	3.20	3.14	3.05	3.11	3.10
	(0.96)	(1.08)	(1.09)	(1.07)	(1.02)	(1.06)	(1.07)
Flows (actual)		-1.55					
		(-0.43)					
Flows (expected)			0.08				
			(0.02)				
Flows (surprise)				-3.02	-4.64		-1.90
				(-0.60)	(-0.91)		(-0.37)
Stock/Debt		-1.87***	-1.88***	-1.87***			-1.82***
		(-5.07)	(-5.13)	(-5.08)			(-4.99)
Stock/Net Issuance					-0.02*		
					(-2.48)		
ciss		0.00	0.00	0.00	0.00	0.00	0.00
		(0.65)	(0.69)	(0.66)	(0.70)	(0.66)	(0.61)
ois_3m		3.03	2.99	2.10	-3.97	1.07	-2.63
		(0.14)	(0.13)	(0.09)	(-0.18)	(0.05)	(-0.12)
ois_3m12m		-1.09	-0.86	-0.52	-10.85	-1.79	-1.28
		(-0.12)	(-0.09)	(-0.06)	(-1.16)	(-0.19)	(-0.14)
eurostoxx		-0.38***	-0.39***	-0.39***	-0.33***	-0.37***	-0.38***
		(-4.59)	(-4.63)	(-4.65)	(-3.93)	(-4.33)	(-4.51)
infl_5y5y		-2.17	-2.19	-2.18	-1.96	-2.15	-2.06

		(-1.37)	(-1.38)	(-1.37)	(-1.21)	(-1.35)	(-1.31)
Flows (surprise) in normal mkt. cond.						-1.19	
						(-0.23)	
Flows (surprise) in stressed mkt. cond.						-18.99	
						(-1.04)	
Stock/debt in normal mkt. cond.						-3.67	
						(-1.43)	
Stock/debt in stressed mkt. cond.						-1.72***	
						(-4.41)	
09apr2020							-8.11**
							(-2.77)
11may2020							-1.95
							(-0.67)
15may2020							3.58
							(1.22)
18may2020							-1.79
							(-0.61)
27may2020							-6.23*
							(-2.14)
21jul2020							0.54
							(0.19)
Constant	0.04	0.26	0.17	0.20	0.15	0.23	0.22
	(0.30)	(1.10)	(0.61)	(1.36)	(1.02)	(1.50)	(1.53)
Observations	471	471	471	471	471	471	471
R^2	0.183	0.279	0.279	0.279	0.248	0.281	0.303

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Spain

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
12mar2020	2.02	-3.93	-3.90	-3.91	-4.61	-3.89	-3.58
	(0.45)	(-0.80)	(-0.79)	(-0.79)	(-0.93)	(-0.78)	(-0.73)
19mar2020	-10.58*	-6.49	-6.49	-6.61	-6.41	-7.49	-6.62
	(-2.36)	(-1.56)	(-1.56)	(-1.59)	(-1.54)	(-1.76)	(-1.60)
26mar2020	-5.08	-7.06	-7.22	-6.94	-6.52	-4.77	-6.91
	(-1.13)	(-1.68)	(-1.72)	(-1.65)	(-1.55)	(-1.00)	(-1.65)
07apr2020	-7.18	-6.57	-6.71	-6.55	-6.53	-5.23	-6.68
	(-1.60)	(-1.59)	(-1.63)	(-1.59)	(-1.58)	(-1.21)	(-1.63)
30apr2020	-1.83	-5.33	-5.35	-5.43	-5.02	-5.37	-5.31
	(-0.41)	(-1.29)	(-1.29)	(-1.31)	(-1.20)	(-1.29)	(-1.29)
04jun2020	-6.88	-4.98	-5.15	-4.86	-4.82	-4.97	-5.03
	(-1.53)	(-1.20)	(-1.25)	(-1.17)	(-1.16)	(-1.19)	(-1.22)
07jul2020	-3.38	-4.52	-4.53	-4.64	-4.61	-4.54	-4.70
	(-0.75)	(-1.10)	(-1.10)	(-1.13)	(-1.11)	(-1.08)	(-1.15)
16jul2020	-0.48	-0.49	-0.55	-0.53	-0.64	-0.53	-0.56
	(-0.11)	(-0.12)	(-0.13)	(-0.13)	(-0.15)	(-0.13)	(-0.14)
27aug2020	-4.68	-6.19	-6.21	-6.29	-6.28	-6.26	-6.32
	(-1.04)	(-1.51)	(-1.51)	(-1.53)	(-1.52)	(-1.52)	(-1.54)
10sep2020	-5.18	-5.77	-5.83	-5.80	-5.83	-5.79	-5.75
	(-1.15)	(-1.40)	(-1.41)	(-1.41)	(-1.41)	(-1.41)	(-1.40)
30sep2020	-4.78	-5.23	-5.22	-5.36	-5.38	-5.30	-5.39
	(-1.07)	(-1.27)	(-1.27)	(-1.30)	(-1.30)	(-1.29)	(-1.32)
29oct2020	-3.38	-3.83	-3.81	-4.00	-3.89	-3.95	-4.10
	(-0.75)	(-0.93)	(-0.92)	(-0.97)	(-0.94)	(-0.95)	(-1.00)
11nov2020	2.02	1.88	1.78	1.89	1.89	1.86	1.92
	(0.45)	(0.46)	(0.43)	(0.46)	(0.46)	(0.45)	(0.47)
26nov2020	-1.68	-1.61	-1.61	-1.74	-1.64	-1.70	-1.73
	(-0.37)	(-0.39)	(-0.39)	(-0.42)	(-0.40)	(-0.41)	(-0.42)
10dec2020	1.22	0.50	0.42	0.48	0.35	0.48	0.50
	(0.27)	(0.12)	(0.10)	(0.12)	(0.09)	(0.12)	(0.12)
11mar2021	-5.18	-5.30	-5.29	-5.33	-5.38	-5.31	-5.32
	(-1.15)	(-1.29)	(-1.29)	(-1.30)	(-1.30)	(-1.29)	(-1.30)
22apr2021	-0.48	-0.13	-0.26	0.03	-0.09	-0.07	-0.05
	(-0.11)	(-0.03)	(-0.06)	(0.01)	(-0.02)	(-0.02)	(-0.01)
10jun2021	-0.48	0.09	0.12	0.04	0.08	0.04	0.04
	(-0.11)	(0.02)	(0.03)	(0.01)	(0.02)	(0.01)	(0.01)
Flows (actual)		-1.59					
		(-0.40)					
Flows (expected)			0.31				
			(0.05)				
Flows (surprise)				-3.79	-2.88		-3.06
				(-0.64)	(-0.48)		(-0.51)
Stock/Debt		0.80	0.78	0.81			0.78
		(1.92)	(1.88)	(1.93)			(1.88)
Stock/Net Issuance					0.00		
					(0.48)		
ciss		0.00	0.00	0.00	0.00	0.00	0.00
		(0.29)	(0.31)	(0.31)	(0.33)	(0.33)	(0.28)
ois_3m		-19.44	-19.77	-20.59	-14.56	-23.11	-29.75
		(-0.63)	(-0.63)	(-0.66)	(-0.47)	(-0.74)	(-0.96)
ois_3m12m		-15.59	-15.13	-14.91	-10.56	-15.46	-10.47
		(-1.18)	(-1.13)	(-1.13)	(-0.79)	(-1.16)	(-0.79)
eurostoxx		-0.89***	-0.89***	-0.89***	-0.92***	-0.87***	-0.90***
		(-7.59)	(-7.60)	(-7.65)	(-7.90)	(-7.36)	(-7.67)
infl_5y5y		-2.74	-2.77	-2.74	-2.88	-2.67	-2.67

		(-1.23)	(-1.24)	(-1.23)	(-1.29)	(-1.20)	(-1.21)
Flows (surprise) in normal mkt. cond.						-2.51	
						(-0.38)	
Flows (surprise) in stressed mkt. cond.						-33.35	
						(-1.10)	
Stock/debt in normal mkt. cond.						0.67	
						(0.22)	
Stock/debt in stressed mkt. cond.						0.93*	
						(2.12)	
09apr2020							2.32
							(0.56)
11may2020							-7.18
							(-1.74)
15may2020							6.91
							(1.67)
18may2020							-6.41
							(-1.56)
27may2020							-6.10
							(-1.49)
21jul2020							0.67
							(0.16)
Constant	0.08	0.22	0.10	0.14	0.19	0.14	0.16
	(0.37)	(0.70)	(0.26)	(0.72)	(0.95)	(0.68)	(0.79)
Observations	471	471	471	471	471	471	471
R^2	0.039	0.206	0.206	0.206	0.200	0.208	0.226

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Italy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
12mar2020	35.37***	7.56	7.35	7.85	4.04	7.69	8.42
	(3.70)	(0.71)	(0.69)	(0.74)	(0.38)	(0.72)	(0.79)
19mar2020	-109.02***	-100.33***	-100.31***	-100.73***	-100.10***	-100.72***	-100.94***
	(-11.41)	(-11.29)	(-11.26)	(-11.32)	(-11.14)	(-11.30)	(-11.38)
26mar2020	-13.18	-11.29	-13.14	-11.27	-10.76	-13.72	-11.47
	(-1.38)	(-1.25)	(-1.46)	(-1.23)	(-1.16)	(-1.37)	(-1.26)
07apr2020	6.68	9.30	7.83	9.01	8.67	7.05	8.51
	(0.70)	(1.04)	(0.89)	(1.01)	(0.96)	(0.74)	(0.95)
30apr2020	-3.67	-8.75	-8.51	-9.25	-4.24	-9.32	-8.98
	(-0.38)	(-0.99)	(-0.96)	(-1.04)	(-0.47)	(-1.05)	(-1.01)
04jun2020	-21.84*	-17.66*	-18.16*	-17.92*	-17.58	-17.73*	-18.28*
	(-2.29)	(-2.00)	(-2.05)	(-2.02)	(-1.97)	(-1.98)	(-2.07)
07jul2020	-0.41	-2.70	-3.00	-3.10	-3.10	-3.09	-3.30
	(-0.04)	(-0.31)	(-0.34)	(-0.35)	(-0.35)	(-0.35)	(-0.37)
16jul2020	-3.02	-3.23	-2.83	-3.69	-3.97	-3.77	-3.69
	(-0.32)	(-0.37)	(-0.32)	(-0.42)	(-0.45)	(-0.43)	(-0.42)
27aug2020	-0.38	-1.88	-1.53	-2.34	-2.29	-2.42	-2.33
	(-0.04)	(-0.21)	(-0.17)	(-0.27)	(-0.26)	(-0.27)	(-0.26)
10sep2020	-4.62	-6.18	-6.08	-6.57	-6.75	-6.57	-6.50
	(-0.48)	(-0.70)	(-0.69)	(-0.74)	(-0.76)	(-0.74)	(-0.74)
30sep2020	-1.25	-2.25	-1.66	-2.78	-3.09	-2.93	-2.77
	(-0.13)	(-0.26)	(-0.19)	(-0.32)	(-0.35)	(-0.33)	(-0.31)
29oct2020	-7.05	-6.69	-5.94	-7.32	-6.58	-7.49	-7.41
	(-0.74)	(-0.76)	(-0.67)	(-0.83)	(-0.73)	(-0.84)	(-0.84)
11nov2020	-5.84	-6.69	-6.34	-7.18	-7.00	-7.22	-7.08
	(-0.61)	(-0.76)	(-0.72)	(-0.81)	(-0.78)	(-0.81)	(-0.80)
26nov2020	-0.67	-0.12	0.36	-0.67	-0.23	-0.75	-0.64
	(-0.07)	(-0.01)	(0.04)	(-0.08)	(-0.03)	(-0.08)	(-0.07)
10dec2020	2.63	0.79	1.10	0.29	-0.11	0.22	0.36
	(0.28)	(0.09)	(0.12)	(0.03)	(-0.01)	(0.03)	(0.04)
11mar2021	-6.61	-6.73	-6.59	-6.81	-7.10	-6.82	-6.81
	(-0.69)	(-0.76)	(-0.75)	(-0.77)	(-0.80)	(-0.77)	(-0.77)
22apr2021	3.83	5.19	4.37	5.32	4.75	5.57	5.09
	(0.40)	(0.59)	(0.50)	(0.60)	(0.53)	(0.63)	(0.58)
10jun2021	-0.56	0.75	1.24	0.65	0.91	0.60	0.68
	(-0.06)	(0.08)	(0.14)	(0.07)	(0.10)	(0.07)	(0.08)
Flows (actual)		-18.62					
		(-1.65)					
Flows (expected)			-20.22				
			(-1.17)				
Flows (surprise)				-22.69	-14.24		-18.98
				(-1.32)	(-0.83)		(-1.07)
Stock/Debt		4.76***	4.53***	4.72***			4.63***
		(4.07)	(3.91)	(4.02)			(3.95)
Stock/Net Issuance					0.02*		
					(2.55)		
ciss		0.00	0.00	0.00	0.00	0.00	0.00
		(0.24)	(0.32)	(0.30)	(0.36)	(0.26)	(0.33)
ois_3m		105.03	109.61	98.62	135.13*	98.38	86.33
		(1.58)	(1.64)	(1.48)	(2.00)	(1.47)	(1.29)
ois_3m12m		-19.11	-19.18	-14.69	-5.27	-13.18	-7.50
		(-0.67)	(-0.67)	(-0.52)	(-0.18)	(-0.46)	(-0.26)
eurostoxx		-1.65***	-1.65***	-1.68***	-1.79***	-1.72***	-1.67***
		(-6.56)	(-6.56)	(-6.74)	(-7.13)	(-6.65)	(-6.62)
infl_5y5y		-8.85	-8.87	-8.98	-9.32	-9.05	-8.86

		(-1.86)	(-1.86)	(-1.88)	(-1.94)	(-1.90)	(-1.86)
Flows (surprise) in normal mkt. cond.						-27.63	
						(-1.39)	
Flows (surprise) in stressed mkt. cond.						0.19	
						(0.00)	
Stock/debt in normal mkt. cond.						4.95	
						(0.60)	
Stock/debt in stressed mkt. cond.						4.47***	
						(3.56)	
09apr2020							0.34
							(0.04)
11may2020							-14.64
							(-1.66)
15may2020							5.71
							(0.64)
18may2020							-20.54*
							(-2.32)
27may2020							-2.53
							(-0.29)
21jul2020							1.56
							(0.18)
Constant	0.05	0.87	0.86	0.07	0.26	0.06	0.12
	(0.12)	(1.27)	(1.00)	(0.17)	(0.61)	(0.13)	(0.28)
Observations	471	471	471	471	471	471	471
R^2	0.254	0.378	0.376	0.376	0.363	0.377	0.388

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Ireland

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
12mar2020	19.01***	5.99	5.78	5.55	8.66	5.57	6.00
	(3.80)	(1.05)	(1.02)	(0.97)	(1.50)	(0.97)	(1.06)
19mar2020	-24.99***	-20.29***	-20.64***	-20.35***	-20.76***	-20.10***	-20.57***
	(-4.99)	(-4.26)	(-4.34)	(-4.26)	(-4.31)	(-4.19)	(-4.35)
26mar2020	-13.99**	-12.30*	-12.20*	-11.86*	-13.16**	-12.12*	-11.86*
	(-2.79)	(-2.55)	(-2.54)	(-2.46)	(-2.71)	(-2.47)	(-2.48)
07apr2020	-4.99	-4.21	-5.26	-4.88	-4.81	-3.92	-5.52
	(-1.00)	(-0.88)	(-1.11)	(-1.01)	(-0.99)	(-0.74)	(-1.15)
30apr2020	-5.24	-6.66	-6.97	-6.63	-4.85	-6.74	-6.77
	(-1.05)	(-1.40)	(-1.47)	(-1.39)	(-1.00)	(-1.41)	(-1.43)
04jun2020	-5.99	-4.90	-4.88	-4.58	-5.02	-4.90	-4.54
	(-1.20)	(-1.03)	(-1.03)	(-0.97)	(-1.05)	(-1.02)	(-0.97)
07jul2020	0.01	-1.75	-1.94	-1.60	-1.61	-1.99	-1.62
	(0.00)	(-0.37)	(-0.41)	(-0.34)	(-0.34)	(-0.42)	(-0.34)
16jul2020	-0.99	-1.54	-1.90	-1.64	-1.26	-1.65	-1.81
	(-0.20)	(-0.33)	(-0.40)	(-0.35)	(-0.26)	(-0.35)	(-0.39)
27aug2020	1.01	0.04	-0.21	0.07	0.11	0.11	-0.08
	(0.20)	(0.01)	(-0.04)	(0.01)	(0.02)	(0.02)	(-0.02)
10sep2020	-3.99	-4.62	-4.74	-4.46	-4.32	-4.50	-4.40
	(-0.80)	(-0.98)	(-1.00)	(-0.94)	(-0.90)	(-0.95)	(-0.94)
30sep2020	-0.99	-1.67	-2.05	-1.76	-1.63	-1.92	-1.94
	(-0.20)	(-0.35)	(-0.43)	(-0.37)	(-0.34)	(-0.40)	(-0.41)
29oct2020	-4.99	-4.89	-5.31	-4.97	-5.20	-5.22	-5.25
	(-1.00)	(-1.03)	(-1.12)	(-1.05)	(-1.09)	(-1.10)	(-1.12)
11nov2020	-2.99	-3.25	-3.17	-2.81	-2.98	-2.89	-2.60
	(-0.60)	(-0.68)	(-0.67)	(-0.59)	(-0.62)	(-0.61)	(-0.55)
26nov2020	-2.99	-2.44	-2.84	-2.50	-2.60	-2.75	-2.71
	(-0.60)	(-0.52)	(-0.60)	(-0.53)	(-0.55)	(-0.58)	(-0.58)
10dec2020	3.01	1.64	1.55	1.93	2.20	2.02	2.04
	(0.60)	(0.35)	(0.33)	(0.41)	(0.46)	(0.43)	(0.44)
11mar2021	0.01	-0.34	-0.41	-0.36	-0.11	-0.28	-0.43
	(0.00)	(-0.07)	(-0.09)	(-0.08)	(-0.02)	(-0.06)	(-0.09)
22apr2021	3.01	2.79	3.03	3.10	3.09	3.23	3.24
	(0.60)	(0.59)	(0.64)	(0.65)	(0.65)	(0.68)	(0.69)
10jun2021	2.01	3.04	2.95	2.93	2.92	2.92	2.78
	(0.40)	(0.64)	(0.63)	(0.62)	(0.61)	(0.62)	(0.59)
Flows (actual)		4.22					
		(0.96)					
Flows (expected)			10.27				
			(1.55)				
Flows (surprise)				-0.48	1.70		-3.63
				(-0.09)	(0.30)		(-0.63)
Stock/Debt		-1.76***	-1.81***	-1.76***			-1.72***
		(-4.06)	(-4.15)	(-4.03)			(-3.98)
Stock/Net Issuance					0.00**		
					(2.91)		
ciss		0.00	0.00	0.00	0.00	0.00	0.00
		(0.27)	(0.32)	(0.20)	(0.16)	(0.22)	(0.11)
ois_3m		26.37	25.16	29.54	0.71	30.04	22.80
		(0.74)	(0.70)	(0.83)	(0.02)	(0.84)	(0.64)
ois_3m12m		31.99*	34.59*	31.22*	23.36	31.70*	31.67*
		(2.10)	(2.26)	(2.05)	(1.55)	(2.06)	(2.08)
eurostoxx		-0.93***	-0.96***	-0.93***	-0.85***	-0.93***	-0.93***
		(-6.98)	(-7.10)	(-6.92)	(-6.34)	(-6.87)	(-6.92)
infl_5y5y		-2.18	-2.24	-2.14	-1.75	-2.13	-1.99

		(-0.85)	(-0.88)	(-0.84)	(-0.68)	(-0.83)	(-0.78)
Flows (surprise) in normal mkt. cond.						-2.03	
						(-0.32)	
Flows (surprise) in stressed mkt. cond.						4.85	
						(0.35)	
Stock/debt in normal mkt. cond.						-0.06	
						(-0.02)	
Stock/debt in stressed mkt. cond.						-1.80***	
						(-4.07)	
09apr2020							-12.16*
							(-2.53)
11may2020							-4.35
							(-0.93)
15may2020							9.62*
							(2.04)
18may2020							-5.89
							(-1.25)
27may2020							-5.01
							(-1.07)
21jul2020							0.45
							(0.10)
Constant	-0.01	-0.13	-0.47	0.17	0.01	0.15	0.23
	(-0.05)	(-0.35)	(-1.00)	(0.72)	(0.02)	(0.59)	(0.99)
Observations	471	471	471	471	471	471	471
R^2	0.107	0.220	0.222	0.218	0.205	0.219	0.243

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Portugal

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
12mar2020	24.88***	0.95	1.05	0.96	2.26	-0.16	2.01
	(3.69)	(0.13)	(0.14)	(0.13)	(0.30)	(-0.02)	(0.27)
19mar2020	-53.12***	-45.75***	-45.62***	-46.12***	-46.51***	-55.85***	-46.33***
	(-7.88)	(-7.31)	(-7.28)	(-7.33)	(-7.33)	(-8.10)	(-7.40)
26mar2020	-23.12***	-20.39**	-20.50**	-20.44**	-21.88***	-18.90**	-20.58**
	(-3.43)	(-3.23)	(-3.25)	(-3.24)	(-3.45)	(-3.02)	(-3.28)
07apr2020	-1.12	-0.31	-0.47	-0.43	-0.54	1.44	-0.60
	(-0.17)	(-0.05)	(-0.08)	(-0.07)	(-0.09)	(0.23)	(-0.10)
30apr2020	-6.37	-9.35	-9.38	-9.55	-9.95	-9.56	-9.45
	(-0.94)	(-1.50)	(-1.50)	(-1.53)	(-1.58)	(-1.54)	(-1.52)
04jun2020	-12.12	-9.08	-9.31	-9.00	-9.23	-9.87	-9.28
	(-1.80)	(-1.46)	(-1.50)	(-1.45)	(-1.47)	(-1.59)	(-1.50)
07jul2020	-1.12	-3.44	-3.54	-3.57	-3.50	-4.26	-3.63
	(-0.17)	(-0.55)	(-0.57)	(-0.58)	(-0.56)	(-0.69)	(-0.59)
16jul2020	-0.12	-0.88	-0.93	-1.03	-0.73	-0.63	-1.07
	(-0.02)	(-0.14)	(-0.15)	(-0.17)	(-0.12)	(-0.10)	(-0.17)
27aug2020	-2.12	-3.42	-3.45	-3.60	-3.53	-3.34	-3.66
	(-0.31)	(-0.55)	(-0.55)	(-0.58)	(-0.56)	(-0.54)	(-0.59)
10sep2020	-7.12	-8.50	-8.55	-8.62	-8.59	-8.37	-8.58
	(-1.06)	(-1.37)	(-1.38)	(-1.39)	(-1.37)	(-1.36)	(-1.39)
30sep2020	-3.12	-4.20	-4.17	-4.45	-4.25	-4.24	-4.48
	(-0.46)	(-0.68)	(-0.67)	(-0.72)	(-0.68)	(-0.69)	(-0.73)
29oct2020	-8.12	-7.60	-7.55	-7.89	-7.91	-7.96	-8.05
	(-1.20)	(-1.22)	(-1.21)	(-1.27)	(-1.26)	(-1.29)	(-1.30)
11nov2020	-3.12	-3.40	-3.58	-3.38	-3.52	-3.49	-3.42
	(-0.46)	(-0.55)	(-0.58)	(-0.54)	(-0.56)	(-0.57)	(-0.55)
26nov2020	-0.12	0.67	0.67	0.44	0.31	0.52	0.37
	(-0.02)	(0.11)	(0.11)	(0.07)	(0.05)	(0.09)	(0.06)
10dec2020	1.88	-0.07	-0.24	-0.08	0.16	0.18	-0.09
	(0.28)	(-0.01)	(-0.04)	(-0.01)	(0.03)	(0.03)	(-0.01)
11mar2021	-2.12	-2.47	-2.46	-2.50	-2.37	-2.17	-2.55
	(-0.31)	(-0.40)	(-0.40)	(-0.40)	(-0.38)	(-0.35)	(-0.41)
22apr2021	1.88	1.82	2.19	1.36	1.55	2.20	1.40
	(0.28)	(0.29)	(0.35)	(0.22)	(0.24)	(0.35)	(0.22)
10jun2021	-0.12	1.41	1.47	1.34	1.28	1.66	1.24
	(-0.02)	(0.23)	(0.24)	(0.22)	(0.20)	(0.27)	(0.20)
Flows (actual)		-2.41					
		(-0.49)					
Flows (expected)			0.04				
			(0.01)				
Flows (surprise)				-5.34	-4.72		-4.48
				(-0.73)	(-0.64)		(-0.61)
Stock/Debt		-1.35**	-1.36**	-1.37**			-1.34**
		(-2.91)	(-2.92)	(-2.95)			(-2.90)
Stock/Net Issuance					0.00		
					(0.84)		
ciss		0.01	0.01	0.01	0.01	0.01	0.01
		(0.88)	(0.94)	(0.86)	(0.83)	(0.88)	(0.84)
ois_3m		91.41	90.80	89.30	80.72	70.86	77.48
		(1.95)	(1.93)	(1.90)	(1.71)	(1.52)	(1.65)
ois_3m12m		23.53	24.23	24.99	10.17	29.29	27.63
		(1.18)	(1.20)	(1.25)	(0.52)	(1.47)	(1.38)
eurostoxx		-1.46***	-1.47***	-1.47***	-1.41***	-1.54***	-1.44***
		(-8.30)	(-8.28)	(-8.38)	(-7.99)	(-8.77)	(-8.15)
infl_5y5y		-5.48	-5.53	-5.49	-5.06	-5.31	-5.25

		(-1.63)	(-1.65)	(-1.64)	(-1.50)	(-1.60)	(-1.57)
Flows (surprise) in normal mkt. cond.						-1.29	
						(-0.17)	
Flows (surprise) in stressed mkt. cond.						-115.94***	
						(-3.41)	
Stock/debt in normal mkt. cond.						1.23	
						(0.39)	
Stock/debt in stressed mkt. cond.						-1.71***	
						(-3.61)	
09apr2020							-5.67
							(-0.91)
11may2020							-7.07
							(-1.14)
15may2020							3.40
							(0.55)
18may2020							-12.42*
							(-2.01)
27may2020							-12.64*
							(-2.05)
21jul2020							-2.22
							(-0.36)
Constant	0.12	0.52	0.32	0.35	0.23	0.10	0.42
	(0.36)	(1.05)	(0.53)	(1.17)	(0.77)	(0.32)	(1.41)
Observations	471	471	471	471	471	471	471
R^2	0.173	0.314	0.313	0.314	0.302	0.331	0.330

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Greece

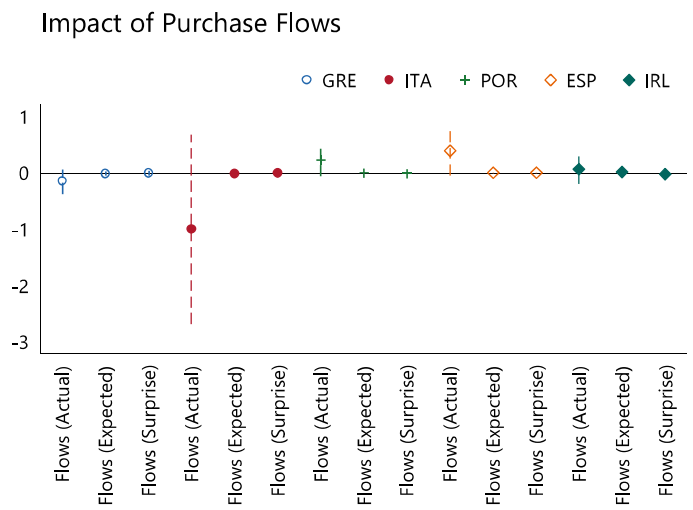
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
12mar2020	58.04***	43.90***	44.05***	44.11***	37.32**	45.03***	45.08***
	(4.81)	(3.35)	(3.36)	(3.37)	(2.81)	(3.44)	(3.42)
19mar2020	-174.96***	-164.58***	-163.56***	-165.68***	-164.97***	-154.61***	-165.77***
	(-14.51)	(-15.03)	(-14.94)	(-14.91)	(-14.54)	(-12.64)	(-14.87)
26mar2020	-41.46***	-48.71***	-48.52***	-49.24***	-45.82***	-48.85***	-49.32***
	(-3.44)	(-4.42)	(-4.40)	(-4.47)	(-4.08)	(-4.44)	(-4.46)
07apr2020	-22.96	-21.20	-21.14	-21.76*	-21.59	-22.35*	-21.85*
	(-1.90)	(-1.96)	(-1.95)	(-2.01)	(-1.95)	(-2.07)	(-2.01)
30apr2020	5.04	-5.28	-5.27	-5.67	-5.99	-5.24	-5.59
	(0.42)	(-0.48)	(-0.48)	(-0.52)	(-0.48)	(-0.48)	(-0.51)
04jun2020	-17.96	-12.25	-12.88	-12.10	-11.56	-11.24	-12.33
	(-1.49)	(-1.12)	(-1.18)	(-1.11)	(-1.04)	(-1.03)	(-1.13)
07jul2020	-1.96	-4.71	-4.81	-5.02	-5.08	-4.45	-5.04
	(-0.16)	(-0.43)	(-0.44)	(-0.46)	(-0.46)	(-0.41)	(-0.46)
16jul2020	-9.96	-9.36	-9.63	-9.46	-10.02	-9.17	-9.51
	(-0.83)	(-0.86)	(-0.89)	(-0.87)	(-0.91)	(-0.85)	(-0.88)
27aug2020	-3.96	-7.93	-7.78	-8.33	-8.42	-8.46	-8.36
	(-0.33)	(-0.73)	(-0.72)	(-0.77)	(-0.76)	(-0.78)	(-0.77)
10sep2020	-5.96	-7.62	-7.49	-7.99	-8.10	-8.25	-7.95
	(-0.49)	(-0.70)	(-0.69)	(-0.74)	(-0.73)	(-0.76)	(-0.73)
30sep2020	-3.96	-4.86	-4.62	-5.32	-5.72	-5.62	-5.33
	(-0.33)	(-0.45)	(-0.43)	(-0.49)	(-0.52)	(-0.52)	(-0.49)
29oct2020	-7.96	-8.84	-8.56	-9.38	-9.27	-9.67	-9.49
	(-0.66)	(-0.81)	(-0.79)	(-0.86)	(-0.83)	(-0.89)	(-0.87)
11nov2020	-1.96	-2.36	-2.53	-2.52	-2.14	-2.32	-2.54
	(-0.16)	(-0.22)	(-0.23)	(-0.23)	(-0.19)	(-0.21)	(-0.23)
26nov2020	-2.96	-2.87	-2.75	-3.27	-2.84	-3.41	-3.32
	(-0.25)	(-0.27)	(-0.25)	(-0.30)	(-0.26)	(-0.31)	(-0.31)
10dec2020	3.04	1.36	1.31	1.08	0.58	1.10	1.11
	(0.25)	(0.13)	(0.12)	(0.10)	(0.05)	(0.10)	(0.10)
11mar2021	-4.96	-5.39	-5.27	-5.54	-5.88	-5.77	-5.54
	(-0.41)	(-0.50)	(-0.49)	(-0.51)	(-0.53)	(-0.53)	(-0.51)
22apr2021	-0.96	-0.11	-0.40	0.06	-0.17	0.35	-0.01
	(-0.08)	(-0.01)	(-0.04)	(0.01)	(-0.02)	(0.03)	(-0.00)
10jun2021	-3.96	-2.59	-2.39	-2.71	-2.66	-3.20	-2.76
	(-0.33)	(-0.24)	(-0.22)	(-0.25)	(-0.24)	(-0.30)	(-0.25)
Flows (actual)		-3.52					
		(-0.93)					
Flows (expected)			-3.43				
			(-0.64)				
Flows (surprise)				-6.06	-6.85		-5.62
				(-0.88)	(-0.97)		(-0.80)
Stock/Debt		1.22***	1.22***	1.21***			1.22***
		(4.43)	(4.44)	(4.39)			(4.41)
Stock/Net Issuance					0.00		
					(0.30)		
ciss		-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
		(-0.24)	(-0.21)	(-0.21)	(-0.13)	(-0.14)	(-0.20)
ois_3m		-18.58	-18.87	-23.38	-7.98	-20.35	-33.10
		(-0.23)	(-0.23)	(-0.29)	(-0.10)	(-0.25)	(-0.40)
ois_3m12m		-71.67*	-71.08*	-68.88*	-33.01	-70.48*	-67.05
		(-2.04)	(-2.02)	(-1.98)	(-0.95)	(-2.02)	(-1.90)
eurostoxx		-2.41***	-2.40***	-2.44***	-2.57***	-2.31***	-2.41***
		(-7.84)	(-7.75)	(-7.97)	(-8.21)	(-7.39)	(-7.76)
infl_5y5y		-7.91	-7.96	-7.99	-9.12	-7.85	-7.83

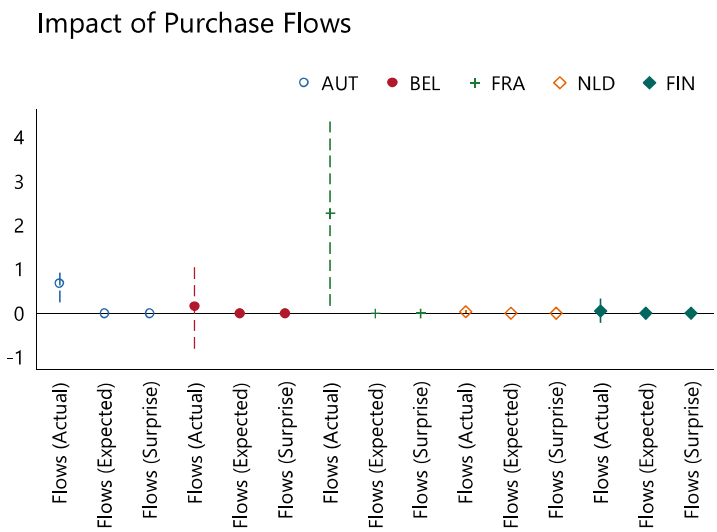
		(-1.35)	(-1.36)	(-1.36)	(-1.53)	(-1.34)	(-1.33)
Flows (surprise) in normal mkt. cond.						-10.93	
						(-1.28)	
Flows (surprise) in stressed mkt. cond.						37.43	
						(1.75)	
Stock/debt in normal mkt. cond.						0.83	
						(0.39)	
Stock/debt in stressed mkt. cond.						1.34***	
						(4.72)	
09apr2020							-9.49
							(-0.87)
11may2020							-5.24
							(-0.48)
15may2020							6.64
							(0.61)
18may2020							-10.72
							(-0.98)
27may2020							-7.91
							(-0.73)
21jul2020							7.41
							(0.68)
Constant	-0.04	0.64	0.52	0.21	0.46	0.45	0.23
	(-0.07)	(0.77)	(0.56)	(0.38)	(0.82)	(0.79)	(0.42)
Observations	471	471	471	471	471	471	471
R^2	0.359	0.493	0.492	0.492	0.471	0.498	0.496

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

IMPACT OF FLOW OF PURCHASES (EXPRESSED AS A SHARE OF NET ISSUANCE)

Chart: Impact of the flow of purchases (expressed in percent of the 12-month rolling sum of net issuance)





Note: The charts show the estimated $\delta^i s$ in (1), the coefficient of the flow of actual purchases. The markers show the point estimates and the dotted lines show the 95% confidence interval. The flow of purchases is measured in percent of the 12-month rolling sum of net issuance, and is expressed in three ways: (i) actual purchases; (ii) expected purchases; and (iii) surprise purchases (defined as actual – expected flows). The estimates are from our preferred specification of (1), including the full set of control variables and expectations for the final stock. Tables 1-10 in the Annex present the numeral results.

PERSISTENCE PROFILES OF ANNOUNCEMENT EFFECTS (FOLLOWING MAMAYSKY, 2018)

Chart: Greece

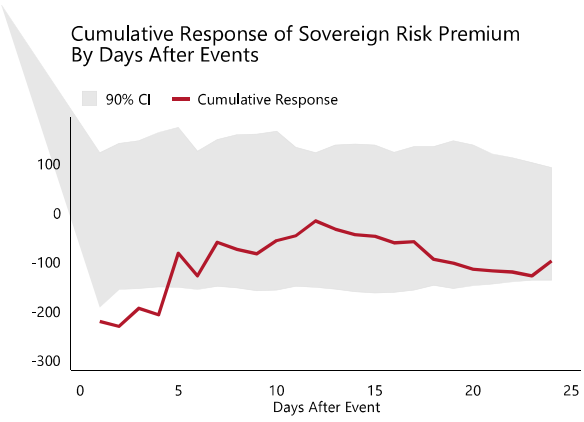


Chart: Portugal

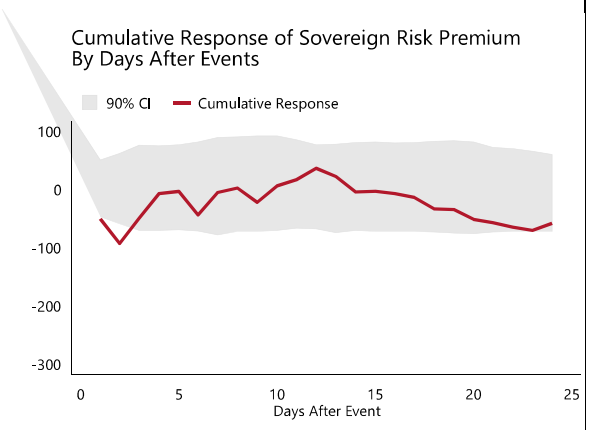


Chart: Ireland

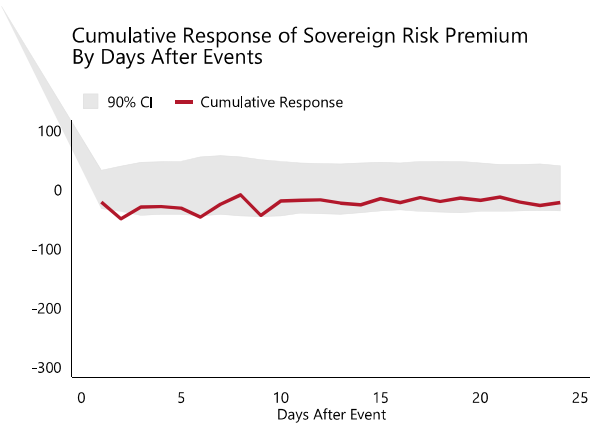


Chart: Spain

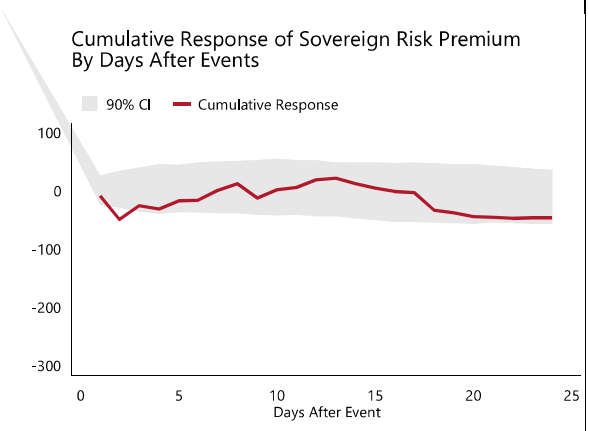


Chart: Italy

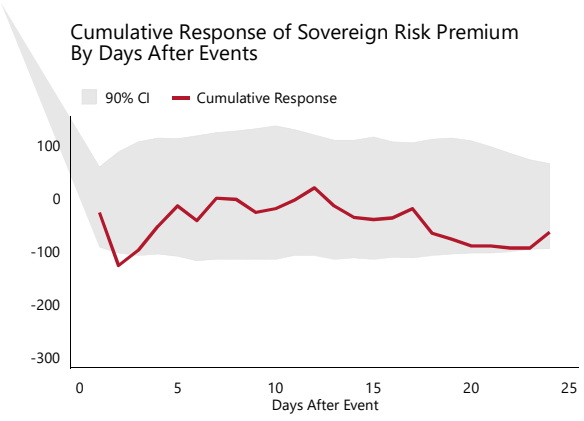


Chart: Austria

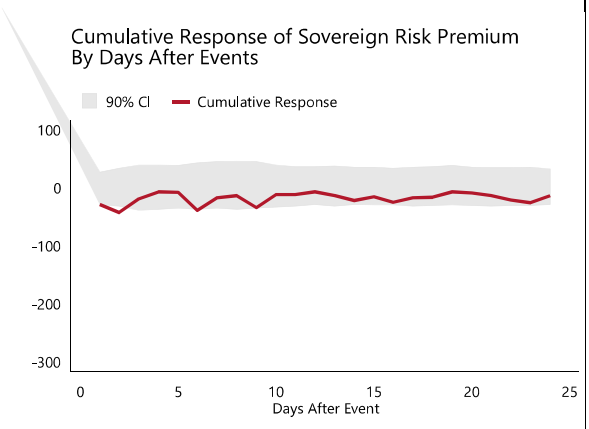


Chart: Belgium

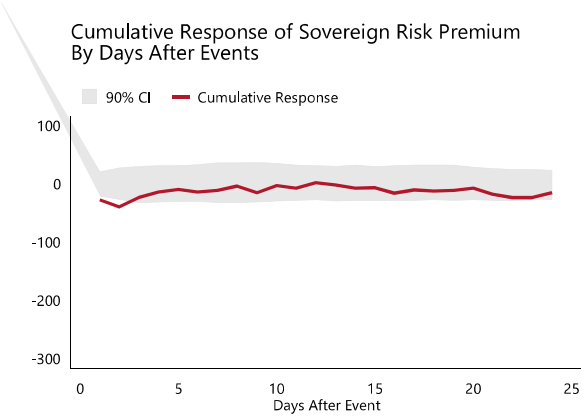


Chart: France

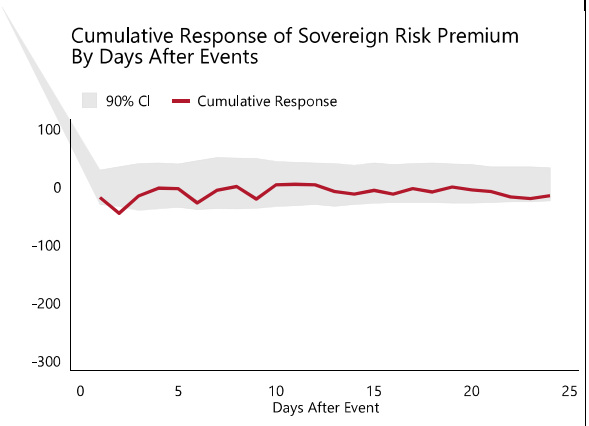


Chart: Netherlands

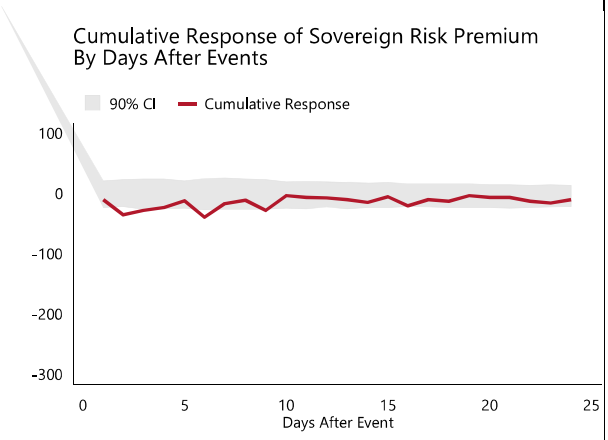
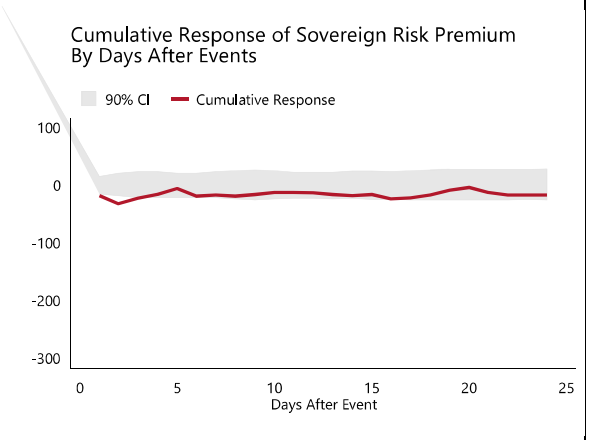
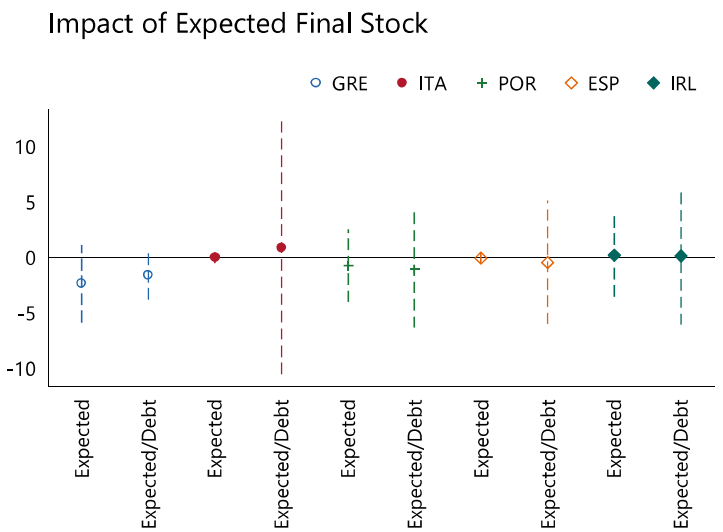


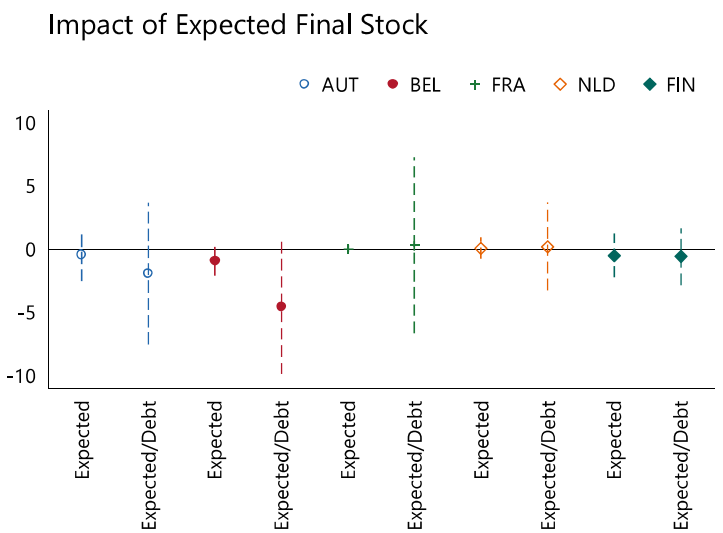
Chart: Finland



ROLE OF EXPECTATIONS IN SUB-SAMPLE

Chart: Impact of evolving expectations of final size of asset purchases for sub-sample starting in May 2020 to June 2021





Note: The charts show the estimated $\gamma^i s$ in (1), the coefficient of the expected final stock variable. The markers show the point estimates and the dotted lines show the 95% confidence interval. Expectations of the final stock are measured in € billions and in percent of outstanding marketable debt. The estimates are from our preferred specification of (1), including the full set of control variables and surprise purchase flows. Tables 1-10 in the Annex present the numeral results.

TABLE: LIST OF ASSET PURCHASE EVENTS INCLUDED IN THE EVENT STUDY

Type	Date	Time	Event	Comment
Governing Council	12 March 2020	13:25	Monetary Policy Decision	APP increased with temporary envelope of €120 billion until end-2020, Lagarde "we are not here to close spreads"
Non-Governing Council	18 March 2020	15:32	*EU WORKING ON PLAN THAT MAY PAVE WAY FOR ECB'S CRISIS PURCHASES	
Emergency Governing Council		23:50	*ECB ANNOUNCES EU750 BLN PANDEMIC ASSET PROGRAM	Waiver for Greece; €750 billion total envelope, flexibility in purchases
Non-Governing Council	26 March 2020	11:15	*ECB SAYS IT STARTED BOND BUYING UNDER EMERGENCY PROGRAM TODAY	Following the release of the legal act on 25 March, the ECB started PEPP.
Emergency Governing Council	07 April 2020	17:46	*ECB DECIDES TO ACCEPT GREEK GOVERNMENT BONDS AS COLLATERAL	Collateral easing measures, reduction in haircuts, wider array of acceptable collateral
Governing Council	30 April 2020	13:45	Monetary Policy Decision	TLTRO eased, PELTRO
Governing Council	04 June 2020	13:45	Monetary Policy Decision	Increase PEPP to €1350 billion, net purchases until June 2021, reinvestment until end-2022, new forecast - downward revision
Non-Governing Council	07 July 2020		*ECB PRESIDENT LAGARDE COMMENTS IN INTERVIEW WITH FT/ *ECB BOARD MEMBER SCHNABEL COMMENTS IN HANDELSBLAD INTERVIEW	
Governing Council	16 July 2020	13:45	Monetary Policy Decision	"exceptionally elevated uncertainty"
Non-Governing Council	27 August 2020	13:51	*LANE SAYS ECB HAS SIGNALED IT STANDS READY TO DO MORE AS NEEDED	"The pandemic emergency: the three challenges for the ECB"
Governing Council	10 Sept 2020	13:45	Monetary Policy Decision	new forecast - upward revisions
Non-Governing Council	30 September 2020	09:27	CHRISTINE LAGARDE SPEAKS AT ECB WATCHERS EVENT: LIVE <GO>	"The monetary policy strategy review: some preliminary considerations" [AIT unlikely, PEPP more likely than rate cuts]
Governing Council	29 October 2020	13:45	Monetary Policy Decision	“recalibrate its instruments, as appropriate, to respond to the unfolding situation” by its next policy meeting in December
Non-Governing Council	11 Nov. 2020	14:03	*LAGARDE SAYS DURATION OF ECB STIMULUS MATTERS AS WELL AS LEVEL	"it is crucial that monetary policy ensures favourable financing conditions for the whole economy "
Non-Governing Council	26 Nov. 2020	13:02	*LANE:	"ensuring favourable financing conditions"
Governing Council	10 December 2020	13:45	Monetary Policy Decision	Increase PEPP to €1850 billion, net purchases until March 2022, reinvestment until end-2023, new forecast - downward revision
Governing Council	11 March 2021	13:45	Monetary Policy Decision	"the Governing Council expects purchases under the PEPP over the next quarter to be conducted at a significantly higher pace than during the first months of this year."
Governing Council	22 April 2021	13:45	Monetary Policy Decision	“the Governing Council expects purchases under the PEPP over the current quarter to continue to be conducted at a significantly higher pace than during the first months of the year.”
Governing Council	10 June 2021	13:45	Monetary Policy Decision	"the Governing Council expects net purchases under the PEPP over the coming quarter to continue to be conducted at a significantly higher pace than during the first months of the year."

Source: Bloomberg and ECB

TABLE: LIST OF EU SUPRANATIONAL FISCAL POLICY EVENTS INCLUDED IN THE ROBUSTNESS CHECK

Type	Date	Time	Event	Comment
European Council	9 April 2020	13:25	Liquidity support	Agreement on €540 billion of liquidity support through SURE, EIB, and ESM
Eurogroup	11 May 2020			Announcement of ESM Pandemic Crisis Support Line
Eurogroup	15 May 2020			Activation of ESM Pandemic Crisis Support Line
German and French Heads of State	18 May		Liquidity support and fiscal transfers	Proposal for a €500 billion fiscal support package, the first towards what would become the Next Generation EU support package
European Commission	27 May 2020		Liquidity support and fiscal transfers	Proposal for a €750 billion of Next Generation EU (NGEU) fiscal support package
European Council	21 July 2020		Liquidity support and fiscal transfers	Agreement on €750 billion NGEU

Source: Bloomberg and ECB

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