ARE ALL CENTRAL BANK ASSET PURCHASES THE SAME? DIFFERENT RATIONALES, DIFFERENT EFFECTS

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ABSTRACT

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KEY WORDS

Monetary policy, Asset prices, Central bank communication, Central bank reaction function, Intermediate objectives.

JEL

E52, E58.

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1. Introduction

This paper documents an original pattern of monetary policy by exploring whether the same policy instrument can produce differentiated effects on the economy. Consider a central bank purchasing the same class of asset, at the same maturity, for the same quantity and to the same counterparty but using two separate programs to do so. These two programs would be very similar in their operational design but would differ in their rationale. This paper investigates the effects of these two asset purchase programs on asset prices.

Assume that a central bank announces it will use a given instrument – for instance, asset purchases – until a particular goal is achieved – for instance, higher inflation or an exchange rate depreciation. The effects of these purchases on financial markets then differ across the two cases because the central bank has effectively announced two different conditional paths of purchases. In the first case, purchases will not stop until inflation increases, whereas in the second case, purchases will not stop until the exchange rate depreciates. Even though the monetary policy instrument is the same in both cases – purchases of identical assets –, the differences in conditionality create two different policies and lead to two different sets of effects on financial markets. By communicating a rationale for a given program, the central bank could thus aim to influence the transmission of its policy.

Two of the asset purchase programs of the European Central Bank (ECB) provide a unique setting to assess how central bank communication about the intermediate objectives of a policy instrument influences investors' beliefs and decisions.[1] During the pandemic, the European Central Bank (ECB) has increased the monthly pace of its asset purchases within the Public Securities Purchase Programme (PSPP) initiated in 2015. It also launched the Pandemic Emergency Purchase Programme (PEPP) consisting in asset purchases as well. Both programs purchase essentially identical assets (euro area sovereign bonds). We explore why the ECB considered having two separate programs using the exact same policy instrument.

Although PSPP and PEPP are two very similar policies, they have been motivated by different rationales. In January 2015, the ECB worried about deflation risks as both inflation and inflation expectations were falling. On 18 March 2020, the PEPP was implemented in response to the pandemic-driven financial and economic crisis as the Eurozone was facing a sharp increase in financial stress on sovereign debt markets. It was announced six days after the ECB President Christine Lagarde stated that the ECB was "not here to close spreads". In a Financial Times column published on 19 March 2020, she then linked the PEPP with the fact that sovereign bond yields had increased and become more dispersed.[2] This paper investigates the effects of both programs on both inflation swaps and sovereign spreads.

Both asset purchase programs have different characteristics in terms of size, length, and purchase flows. In practice, these differences appear minor. One operational difference that held attention is the flexibility with regard to the distribution by country of PEPP asset purchases whereas the PSPP had to comply with the ECB capital key.[3] In practice though, there were deviations – small but not negligible – from the capital key under the PSPP, and more importantly, PEPP asset purchases did not deviate from the capital key for most countries,

[1] Both programs share the same final objective, and the ECB always asserted that these asset purchases contribute to supporting economic activity in order to maintain price stability over the medium term.
[2] See the original extract of the Financial Times article in Section A of the Appendix.
[3] However, it was clear from the March 2020 statement that the capital key for PEPP purchases will have to be respected in the end, so market participants could anticipate opposite flows to offset initial deviations.

except for French and Italian bonds (under- and overpurchased respectively) during the first months only. The difference between both programs in terms of their actual flexibility is thus relatively weak in the data. However, the *flexibility announcement* conveys a strong signal to financial markets that the ECB is willing to effectively reduce sovereign spreads. It makes the overall PEPP announcement credible, reinforcing the rationale about sovereign spreads. The ECB communication when both programs were implemented, that includes communication about this operational feature, thus suggests that their respective rationales were different.

Based on the key difference in the two programs, we compare their relative impact on two asset prices: inflation swaps and euro area sovereign spreads, each variable capturing the respective "intermediate" objective of one of the programs. We estimate both announcement and implementation effects. Indeed, beyond the ECB policy announcement that signals which variables enter the central bank reaction function, the actual implementation of each program may provide information to investors. Each week, the Eurosystem conducts asset purchases under both programs. When observing these flows, investors could extract information about the weight given to each intermediate objective in the central bank reaction function.

While there is an abundant empirical literature on the effect of asset purchases, our contribution is to compare the announcement and implementation effects of two quasi-similar programs on their two different intermediate objectives.[4] One key aspect of the monetary transmission mechanism is the role of central bank communication in influencing private beliefs about the central bank reaction function. The features of ECB asset purchases offer a unique setting that enables us to properly identify whether communicating a rationale underlying a policy decision matters for its transmission and through which channels.

To investigate our research question, we follow two different empirical approaches. We first resort to an event-study methodology to estimate and compare the effect of PSPP and PEPP announcements on both market-based inflation expectations and sovereign spreads.[5] We pay attention to controlling for the financial context and how liquidity and volatility evolved across time. Second, we assess whether the actual flow of asset purchases under each program influences differently inflation expectations and sovereign spreads. Because weekly purchase flows are likely to be endogenous to the dynamics of inflation expectations and sovereign stress, we use a two-step identification approach to overcome endogeneity issues.[6] We start by isolating the exogenous component of asset purchase flows – within both programs – for a given week not explained by sovereign spreads and inflation swaps on the preceding weeks. We then use these residuals as instruments to estimate the effects of the exogenous component of asset purchase flows during a given week on sovereign spreads and market-based inflation expectations at the end of this and the following weeks.

The main result of this paper is that the PSPP and PEPP are not substitutes. We find that ECB purchases of the same assets do not produce the same effects whether they relate to the PSPP or PEPP. According to the event-study, PSPP announcements have a positive impact on 5-year 5-year-forward inflation swaps whereas PEPP announcements have no significant impact. Concerning euro area sovereign spreads, the effect of PEPP announcements is twice as large as the one of PSPP announcements. Those results hold when controlling for the effects of intraday monetary surprises - identified by Altavilla et al. (2019) -, other policy announcements

[4] See e.g. Krishnamurthy et al. (2018), Lewis and Roth (2019), De Santis (2020) and Swanson (2021).

[5] The event-study can also be viewed as revealing how the policy and its objective was interpreted by financial market participants at the announcement. It provides an indication of the perceived rationale.

[6] The monthly pace of PSPP purchases is supposed to be pre-determined, but not weekly flows. Regarding the PEPP, only the total envelope has been announced leaving room for maneuver to adjust weekly purchases.

and the level of financial stress. Our results suggest that by communicating a rationale for these two programs, the ECB is able to signal which variable enters its reaction function such that these policy announcements primarily affect the respective variables. This interpretation is consistent with our finding that the first announcement for each program (22 January 2015 for the PSPP and 18 March 2020 for the PEPP) has larger impact than later ones, suggesting that investors instantly update their beliefs about the reaction function.

We also find that actual asset purchase flows matter, such that not only announcements but the implementation produces differentiated effects. PSPP purchases influence 5-year 5-year-forward inflation swaps up to three weeks after they are implemented. A 1% increase in PSPP flows increases inflation swaps by 1.65 basis point (bp) after 3 weeks. At the opposite, a 1% increase in PEPP purchases reduces the mean of euro area spreads by 1.61 bp after one week. We find no evidence of an effect of PSPP flows on spreads and of PEPP flows on inflation swaps. These results are robust to the inclusion of various control variables (financial market volatility, US monetary policy surprises, the number of COVID deaths, macroeconomic surprises as measured by Scotti, 2016) and alternative specifications of the first-stage equation. The effects of both programs on their respective intermediate objectives suggest that investors infer information from PSPP and PEPP weekly purchases. Our interpretation is that policy announcements provide information about the variables entering the ECB reaction function, while the implementation conveys information on the reaction function parameters. This in turn affects investors' beliefs and decisions as observed through asset prices.

A potential concern with our estimates is that they may reflect differences in operational features more than in rationales. Although PEPP asset purchases did not deviate from the capital key for most countries, they did so for purchases of French and Italian sovereign bonds. We therefore estimate the PSPP and PEPP effects on a measure of sovereign spreads that excludes these two countries, as well as on their respective spread relative to Germany. We find that the differentiated effects of PSPP and PEPP on all other spreads is at work without these two countries (so when the capital key is enforced) and for each of the two countries (so the pattern is not a mechanical consequence of buying more Italian bonds, especially as it is at work as well for underpurchased French bonds). Thus, our main result is not driven by capital key deviations.[7] Another difference relates to the size of the announcement, the PEPP being perceived as a much bigger envelope than the PSPP (€60 billion per month for the latter against €750 billion for the former). Because the ECB committed to run the PSPP over 18 months initially, the amount announced was actually €1080 billion overall, so the PSPP and PEPP program sizes are actually much more comparable.

One could also argue that the context was different at both times, in terms of financial market conditions or fiscal policy for instance. Financial stress in general was much higher during the Covid-19 crisis than in 2015 while inflation swaps were falling at that time. So an explanation for the different effects would be that one variable, but not the other, required intervention when each program was implemented. The fact that inflation swaps were at a lower level in 2020 than in 2015 downplays this explanation. To further explore this issue, in the event-study, we normalize asset price changes by their recent volatility (over the preceding 50 days) such that our PSPP and PEPP estimated effects are conditional on whether these asset prices required intervention. Our main result is robust to this alternative specification.[8] The fiscal

[7] Conceptually, the case for why PEPP flexibility would affect inflation swaps differently than the PSPP is unclear.
[8] We also estimate the PSPP and PEPP effects on each of the 10 individual sovereign spreads. Although these individual spreads exhibit large cross-sectional dispersion, the PSPP and PEPP effects on sovereign spreads are relatively homogeneous across individual countries. This suggests that the effect of both programs is not driven by the pre-existing conditions on these variables.

policy stance was much more expansionary in 2020 than in 2015, so its effects on sovereign stress for countries with debt sustainability issues and on inflation expectations would be higher in 2020 due to the large fiscal stimulus. Our estimates of the effects of PSPP and PEPP go in the opposite direction and suggest that this potential confounding factor does not drive our results.[9]

Another concern could be that the PSPP announcement regarding its rationale was much more precise than the PEPP announcement. It explicitly stated that purchases would continue until there is "a sustained adjustment in the path of inflation". In contrast, implemented during the financial and economic crisis caused by the pandemic, PEPP objectives do not seem as clear. The PEPP statement is general and states that purchases would continue until the "Covid-19 crisis phase is over". In practice, however, the PEPP was clearly linked to sovereign risks, from the perspective of both the ECB (see the discussion above about Christine Lagarde's interventions on 12 and 19 March 2020) and ECB watchers. Press articles (see section 2 and section A of the Appendix) clearly interpreted the PEPP rationale being about sovereign risks.

A fundamental policy implication of our main result highlights the potential benefit of central bank asset purchases as a monetary policy instrument. Two asset purchase programs can be implemented with different effects such that the same instrument could reach two objectives whereas this is not the case for the interest rate instrument. Our results suggest that central banks could make use of this additional flexibility to achieve their objectives.

This paper relates to the existing literature in several respects. First, it analyses the role of communication in conveying information on policymakers' preferences (Blinder et al., 2008). It also relates to the literature that shows that communication strategies may produce a benchmark for assessing central bank performance (see Woodford, 2005, Eusepi and Preston, 2010, Gürkaynak et al., 2010, Schmidt and Nautz, 2012, Davig and Foerster, 2021, and Leombroni et al., 2021): communicating more than an inflation target, like an intermediate objective, may help steer private expectations. Second, the paper relates to numerous empirical studies on the effects of asset purchase announcements on asset prices. Guidolin and Neely (2010), Hofmann and Zhu (2010), Krishnamurthy and Vissing-Jorgensen (2011), Gagnon et al. (2011), Joyce et al. (2011), Wright (2012), Glick and Leduc (2012), Rogers et al. (2014), Szczerbowicz (2015), Altavilla et al. (2016), Haitsma et al. (2016), Ghysels et al. (2017), Afonso et al. (2018) De Pooter et al. (2018), Moessner (2018), Altavilla et al. (2019), Lewis and Roth (2019), Pagliari (2020), Altavilla et al. (2021), Lhuissier and Nguyen (2021), Costain et al. (2021) and Swanson (2021) all investigate the effects of different asset purchase programs in different countries. We differ from these contributions by differentiating the effects of both asset purchase programs on both asset prices that are identified as each program respective rationale. Finally, the closest paper to ours is Lunsford (2020) that shows that the nature of the language used in forward guidance announcements in the United States (US) influences investors' responses to monetary policy statements. Variations in the expected path of policy rates have differentiated effects on financial and macroeconomic variables depending on the forward guidance language. Our paper aims to shed light on a similar pattern, but through the communication of a rationale for a given asset purchase program.

[9] Said differently, the role of fiscal policy effects as a potential confounding factor would lead to an under-estimation of the "true" impact of PEPP on inflation swaps and sovereign spreads.

2. The PSPP and PEPP institutional backgrounds

The identification of the causal effect of asset purchases under the PSPP and PEPP and their interpretation relies on the assumption that both programs are very close in their operational design, but different in their rationales. We describe how the differences on paper in the two programs – size, capital key breakdown and purchase flows – are arguably negligible in practice. This setting enables us to isolate the effect of policymakers' communication about the distinct rationales for these two policies.

The PSPP was announced on 22 January 2015 and purchases started in March 2015.[10] It was introduced to counter deflationary risks. It consists in purchases of government bonds which could include nominal and inflation-indexed assets, with a monthly pace of purchases of €60 billion up to September 2016. The monthly target for the purchase flows has been adjusted on several occasions thereafter, upward or downward, and the program end has been postponed regularly. Since September 2019, there is no announced deadline for these purchases which are now conducted "as long as necessary". A key dimension of this asset purchase policy relates to the cross-country allocation: purchases are realized according to the ECB capital key, so in proportion to the respective size of Eurosystem countries.

The PEPP was announced on 18 March 2020 to counter sovereign and fragmentation risks raised by the asymmetric nature of the Covid-19 shock, with a list of eligible assets similar to the APP.[11] Initially, purchases were expected to be conducted until the end of 2020. Instead of announcing a monthly pace of purchases, the ECB communicated on a total envelope (initially €750 billion). Eventually, there is a strong equivalence between announcing purchase flows over a given period (€60 billion per month over 18 months for the PSPP, so €1080 billion) and a total envelope until a given date (€750 billion over 9 months for the PEPP). Like the PSPP, the PEPP has then been expanded (until 2022 for a total amount of €1850 billion). Finally, PEPP purchases do not follow a given pre-determined monthly pace and may be implemented in "a flexible manner" regarding their geographical breakdown. This meant that purchases could deviate from the capital key across time. However, the ECB also announced at the same time that PEPP purchases eventually have to comply with the ECB capital key, so deviation in one direction will be compensated later by the opposite deviations.

Regarding their operational design, both programs are very similar. Although in theory, the issue of the capital key constraint is different for both programs, in practice, the capital key is not necessarily respected for *both* PSPP and PEPP programs. In September 2017, this issue was raised for the PSPP, as the ECB had purchased a higher share of Italian and French bonds. Mario Draghi recognized that "there have always been temporary deviations from the capital key" (Press conference, 07/09/2017) because of market liquidity conditions. At the opposite, PEPP purchases, despite the "flexible manner" option, have been well aligned with the capital key, except for French and Italian bonds during the first months of the program. One common feature is that the capital key will have to be respected in the end for both programs. Figure 1

[10] The PSPP is part of a broader Asset Purchase Programme (APP) that includes the CBPP3 (Covered-Bond Purchase Programme), ABSPP (Asset-Backed Securities Purchase Programme) and CSPP (Corporate Securities Purchase Programme). PSPP purchases represent more than 80% of all APP purchases. CBPP3 and ABSPP purchases started earlier, in October and November 2014 respectively, and were included in the APP on 22 January 2015. The CSPP was launched later, and purchases started in June 2016.

[11] The bulk of PEPP purchases involves public securities. One key difference with the PSPP is the eligibility waiver for Greek sovereign bonds.

shows deviations from the capital key for both programs.[12] PSPP deviations are small but not negligible while PEPP deviations only apply to French and Italian bonds. Overall, the difference in flexibility appears relatively weak in the data.

In addition, as often claimed by central banks about their unconventional tools, asset purchases were expected to be temporary and used under exceptional circumstances only, so they should not be seen as a permanent tool of monetary policy. Both PSPP and PEPP were first announced for some months. After 6 years the PSPP is still ongoing and as the PEPP termination date has already been postponed twice, one may expect that it could last longer. Finally, the "flexible manner" characteristics of the PEPP also refers to the pace of purchase flows from one week to another. This feature appears, on paper, different from the pace of PSPP flows that seems strictly determined. However, they are only determined at the monthly frequency, and more importantly, in practice, the variability of PSPP and PEPP purchase flows is extremely close. The standard deviation of weekly PSPP and PEPP flows is 6.41 and 6.62 €billion, respectively.

Ultimately, the key difference between the PSPP and PEPP lies in their intermediate objectives. As stated in the Introductory Statement released on 22 January 2015, the PSPP was initiated to counter deflationary pressures ("inflation dynamics have continued to be weaker than expected", "further fall in market-based measures of inflation expectations", "expected inflation stand at, or close to, their historical lows"). Figure 2 shows the evolution of inflation swaps in the years around the PSPP implementation. Changes in the pace of purchases also relates to deflation risks. For instance, on 10 March 2016, Mario Draghi motivated the expansion of monthly purchases to €80 billion by "heightened risks to the ECB's price stability objective" and the 12 September 2019 decision to restart purchases was "taken in response to the continued shortfall of inflation".[13] Conversely, all decreases in the pace of purchases intervened when the inflation outlook improved. Thus, most communication motivating the PSPP refers to inflation and inflation expectations at their lowest levels.

The PEPP announcement occurred in the context of the financial and economic crisis caused by the pandemic. The PEPP statement was more general than the PSPP one and stated that purchases would continue until the "Covid-19 crisis phase is over", so PEPP objectives might not seem as clear as PSPP ones. However, the PEPP was clearly interpreted as a response to the financial effects of the Covid-19 crisis, which triggered an asymmetric increase in sovereign stress, directly related to the spread of the virus in euro area countries. Financial markets feared that fiscal responses would undermine public debt sustainability, especially for a couple of fragile countries. The PEPP announcement followed Christine Lagarde's comment that the ECB was "not here to close spreads" on 12 March 2020 – that amplified sovereign stress – and made clear that the PEPP aimed to respond to sovereign risks ("fully committed to avoid any fragmentation", "high spreads impair the transmission of monetary policy", "the ECB will not tolerate any risks (…) in all jurisdictions of the euro area"). Figure 2 plots the evolution of sovereign spreads around the PEPP enactment. While justifying the PEPP on 4 June 2020, Christine Lagarde reiterated that the PEPP is expected "to address the risk of market

[12] Country breakdowns of bonds' holdings for PSPP and PEPP is available on the ECB website, but not at the weekly frequency. PEPP purchase breakdown is only available for irregular spans of 2 or 3 months, while PSPP purchase breakdown is available at the monthly frequency.

[13] The reduction of the monthly pace of purchases announced on 26 October 2017 reflected "growing confidence in the gradual convergence of inflation towards our inflation aim".

segmentation" in the euro area.[14] Press articles from the Financial Times, Wall Street Journal or Reuters, on 19 March 2020, show that the PEPP was noticeably linked to sovereign risks and that the PEPP rationale was clearly interpreted that way. In addition, although the actual deviations from the capital key are actually limited, the flexibility announcement reinforced that the PEPP was about sovereign risks and that the ECB will be technically able to reduce sovereign spreads. The possibility for capital key deviations should be seen as a signal strengthening the rationale of the PEPP and making the overall policy announcement credible.

Another potential important issue relates, not to the operational features but, to the environment of both programs. The fiscal policy context was different at both times. The fiscal policy stance was much more expansionary in 2020 than in 2015, so sovereign stress for countries with debt sustainability issues would be larger in 2020. In addition, the expansionary fiscal stance of 2020 would push inflation expectations up. Our estimates of the effects of PSPP and PEPP on inflation swaps and sovereign spreads go in the opposite direction and suggest that this potential confounding factor does not drive our results.

It may be argued that the Securities Market Programme (SMP), launched in May 2010, is close to the PEPP regarding its main objective. It consists in purchases of the same assets (i.e. sovereign bonds) and its goal was explicitly to deal with fragmentation risks in euro area sovereign debt markets. However, it would not be relevant to consider this program in our empirical strategy. A key operational feature of the SMP is to purchase sovereign bonds only from countries under stress. In that case, the effect on sovereign yields and therefore on spreads is mechanical. The crucial feature of the comparison between the PSPP and PEPP is that purchases are implemented according to the capital key, so when the Eurosystem purchases sovereign bonds from countries under stress, it also purchases German bonds and even more than from countries under stress through the institutional constraint. So the effect on spreads does not boil down to a simple market effect of ECB excess demand for sovereign bonds from one specific country.

Besides, the dichotomy between inflation expectations and sovereign spreads can be interpreted in a different but closely related fashion. The PSPP set-up can be linked to the reassertion of the ECB mandate and its inflation target. This policy was introduced when inflation expectations were at historical lows and the ECB needed to reaffirm its capacity to reach its inflation target. At the opposite, the PEPP set-up can be linked to a cyclical shock (in contrast to a low-frequency shock to investors' beliefs about the inflation target) hitting the euro area asymmetrically and generating sovereign and fragmentation risks. These alternative rationales also provide information related to the ECB asset purchase reaction function and how policymakers react to deviations from the inflation target and to an asymmetric shock. This alternative interpretation of the difference between the PSPP and PEPP implies focusing on inflation expectations and sovereign spreads.

There is a direct analogy with communication aiming at clarifying the reaction function that guides how the central bank sets the policy rate. By communicating on its intermediate objectives, the central bank provides information to private agents on the variables entering the reaction function for asset purchases. Observing how weekly flows respond to these intermediate objectives, private agents may then be able to infer the relevant parameters of the

[14] On 10 December 2020, the ECB updated its language towards the idea of "preserving favourable financing conditions" in order to include households and corporate interest rates in jurisdictions where they may be tightening and not focus exclusively on divergence in sovereign interest rates.

reaction function. Consequently, not only policy announcements matter but also the implementation of asset purchases.

Building on the rationale communicated to the public by the ECB for its otherwise-similar asset purchase programs, we first assess whether communicating a rationale for a given policy – therefore informing investors about the variable entering the central bank reaction function – matters for the transmission of this policy. Second, we analyze whether weekly purchase flows inform investors about the relevant parameters of the reaction function. The next two sections study the effects on inflation expectations and sovereign spreads of policy announcements and purchase flows, respectively.

3. The signaling effect of policy announcements

We investigate the effects of both asset purchase programs on market-based inflation expectations and sovereign spreads with an event-study. As these policy decisions have been communicated through press releases at specific dates, this approach is well suited to measure the reaction of asset prices on days of policy announcements. The event-study methodology consists in estimating the effect of policy decisions on changes in asset prices within a short window around the relevant event. Considering that no other event occurred in the same window, the high-frequency change in asset prices can be attributed to the policy announcement. The key assumption is that, since asset prices adjust in real-time, the latest price before the start of the window reflects all information and expectations before the event and that movements during the window only reflect the effect of the policy announcement. This is crucial for identification since it strips out the endogenous variation in asset prices associated with other shocks. Using daily data, Cook and Hahn (1989), Kuttner (2001) or Cochrane and Piazzesi (2002) have initiated this approach. This methodology is thus well-suited to tackle the potential issue that one of the two programs might have been more anticipated than the other (the possibility for a PSPP-like program was discussed by many ECB watchers in 2013 and 2014 for instance).[15] In that case, asset prices at the start of the window should incorporate these anticipation effects. Thus, the change in asset prices on the announcement day would only capture the revision of private agents' information set after the ECB disclosed the program details. Finally, the event-study approach, by focusing on financial market participants' reactions, also tells how both policy announcements (and their stated objectives) have been perceived. It provides an indication of the relevance of the different rationales for both programs from the investors' perspective.

The effects of PSPP and PEPP announcements are assessed using the following two equations:

$$\Delta\pi_t^e = \alpha + \beta_{pspp} I_t^{PSPP} + \beta_{pepp} I_t^{PEPP} + \theta Z_t + \mu_t \quad (1)$$

$$\Delta spread_t = \alpha' + \gamma_{pspp} I_t^{PSPP} + \gamma_{pepp} I_t^{PEPP} + \theta' Z_t + \mu_t' \quad (2)$$

where $\Delta\pi_t^e$ is the daily change in market-based inflation expectations and $\Delta spread_t$ an indicator of the daily change in sovereign spreads. The dummy variables I_t^{PSPP} and I_t^{PEPP} capture the PSPP and PEEP announcements. Z_t is a vector of control variables. Equations (1) and (2) are estimated with OLS using Huber-White heteroskedasticity-robust standard errors, from 1 January 2009 until 23 March 2021 and for announcement days only. We thus assess whether PSPP and PEPP announcements provide relevant information to investors above and beyond the other information conveyed by the ECB throughout these 123 meetings.

[15] See De Santis (2020).

We consider all dates at which the flow of purchases has been modified.[16] The dummy variables take the value 1 (resp. -1) when the size of the program increases (resp. decreases). All announcements, but the launch of PEPP on 18 March 2020, happened during press conferences held after Governing Council meetings. PSPP purchases began in March 2015, but the announcement was made on 22 January 2015, so our dummy takes the value one on this date. The PEPP launch was announced through a press release at 23.53 CET time in the evening of 18 March 2020, so the effects on European financial markets can only be observed on 19 March 2020. Hence, the dummy variable I_t^{PEPP} takes the value 1 on this date.

Inflation expectations are measured by 5-year in 5-year-forward inflation swaps, which are the most commonly used indicator of market-based long-term expectations.[17] We also assess whether the result holds with the 10-year forward inflation swaps. We compute $\Delta spread_t$ as the first principal component of 10 sovereign spreads across 10 euro area countries.[18] Sovereign spreads are computed as the difference between each country's 10-year sovereign yield and the one of Germany.[19] The main advantage of a principal component analysis – which is essentially a weighted average – is to lower the weight for outlier series and therefore maximize the common variance of the 10 series explained by one single metric. We also assess the robustness of our results with the mean of these 10 sovereign spreads. All dependent variables have been normalized to a unit standard deviation so the announcement effects are comparable.

The vector of control variables includes intraday monetary policy surprises as measured by the change in 2-year OIS rates by Altavilla et al. (2019).[20] For 19 March 2020 and the PEPP launch outside a scheduled Governing Council meeting, we consider the daily change in 2-year OIS rates on that day. We also include the change in the implied stock market volatility (VSTOXX) in order to control for potentially different market conditions across time – in terms of financial stress and liquidity (see Bernardini and De Nicola, 2020), and a dummy for other ECB policy announcements.[21]

Considering the ECB communication strategy, we test the following hypotheses:

Hypothesis 1: PSPP affects positively inflation expectations, so $\beta_{pspp} > 0$. We do not make any strong hypothesis regarding β_{pepp}. We cannot rule out that PEPP announcements imply an improvement of the euro area economic outlook, so an increase in inflation expectations. In the meantime, investors may consider that the treatment for inflation expectations is already embedded in the PSPP, so there would be no marginal effect.

[16] See Table A in the Appendix. Although the number of announcement events is relatively limited, estimates of the implementation effects using weekly purchase flows provide similar results (see next section).
[17] See for instance Gürkaynak et al. (2010) and Wright (2012). Inflation swaps are a measure of compensation for expected inflation and risk premia. We do not aim to disentangle both as one of the transmission mechanisms of asset purchases is arguably to affect risk premia. In any case, including a proxy for volatility risk premia, the VIX, in our regression analysis controls for these dynamics such that the estimated effects of both asset purchase programs on inflation swaps are not driven by a risk premia factor.
[18] Italy, Spain, Portugal, Greece, Ireland, France, Netherlands, Belgium, Austria and Finland. Table C in the Appendix shows the eigenvalues of the principal component analysis of the 10 daily series. The first principal component explains 72% of the variance of all 10 series and its correlation with the mean of the 10 spreads is 0.95.
[19] The reaction of sovereign yields to asset purchases can be decomposed according to their effect on expectations of the policy rate future path, the term premia and the sovereign risk premia. Considering 10-year sovereign rates, we capture the impact of policy announcements on the sovereign risk as the future path of the policy rate and the term premia are common to all euro area countries. Krishnamurthy et al. (2018) decompose the sovereign risk between a redenomination risk and a market segmentation effect.
[20] We consider the full monetary event that goes from the press release to the end of the press conference.
[21] See Table B in the Appendix for these other policy announcements.

Hypothesis 2: PEPP affects negatively sovereign spreads, so $\gamma_{pepp} < 0$. Although sovereign risks have not been an explicit intermediate objective of the PSPP, there is empirical evidence that PSPP announcements have dragged down sovereign yields.[22] It cannot be excluded that the effect is stronger for fragile countries, which would result in a reduction of spreads, so we expect $\gamma_{pspp} < 0$. However, given the emphasis put on sovereign risks for PEPP announcements, we expect $\gamma_{pspp} < \gamma_{pepp}$.

Table 1 shows the estimates for both inflation swaps and sovereign spreads. In the baseline specification (column 1), we control for stock market implied volatility, monetary policy surprises and TLTRO announcements. The upper-panel results show that PSPP announcements have a positive effect on inflation swaps while PEPP ones have no significant impact. The bottom-panel results show that both PSPP and PEPP announcements have a negative impact on sovereign spreads. However, the point estimate for the PEPP is more than two-times larger than for the PSPP. If we normalize this effect by the size of the programs announced (the PSPP being larger than the PEPP), the difference is even more pronounced. This suggests that investors have responded more to the asset purchase program announcements which put forward sovereign spreads at the core of their rationale.

In column (2), we assess the impact of PSPP and PEPP announcements on 10-year inflation swaps and the mean of euro area sovereign spreads and find a similar pattern, although the negative PEPP effect on sovereign spreads is significant at the 10% level only.[23] We then control for Scotti (2016)'s macroeconomic news surprises (column 3), for ECB announcements of liquidity measures (column 4), for ECB announcements about the length of the PSPP purchases (column 5). All three tests confirm the differentiated effects of the two programs. In column (6), we replace the intraday measure of monetary surprises by the daily change in 2-year OIS rates in order to capture slow reactions to other policy announcements that we would have attributed to our PSPP and PEPP dummies. In column (7), we restrict our dummies of interest to the first announcement for each program (22 January 2015 and 18 March 2020). If the pattern observed in our result is sound, it should be magnified when the first signals about which variables enter the ECB asset purchase reaction function are disclosed. Finally, in column (8), we normalize the daily change in our dependent variables by their standard deviation over the preceding 50 business days. Our baseline result might be driven by the fact that market conditions and in particular the volatility of our two dependent variables varied over our sample. Estimates for these additional tests provide supporting evidence that the two programs have different effects on the two variables identified as intermediate objectives.

A potential concern with our estimates is that they may reflect differences in capital key deviations between the PSPP and PEPP more than in rationales. Although PEPP asset purchases did not deviate from the capital key for most countries, they did for purchases of French and Italian sovereign bonds, in the first months of the program only. To explore this possibility, we estimate, based on equation (2), the PSPP and PEPP effects on two measures (first principal component and mean) of sovereign spreads that exclude these two countries. We also estimate the PSPP and PEPP effects on the spread, relative to German bonds, of Italian bonds (that are overpurchased) and French bonds (that are underpurchased). If the difference between PSPP and PEPP effects is driven by the "mechanical" effect of PEPP capital key deviations (the "flexibility manner"), spreads of countries in line with the capital key should

[22] See Altavilla et al. (2021) for instance.

[23] The effect of PSPP and PEPP on sovereign spreads is homogeneous across countries. We have estimated equation (2) for each of the 10 individual spreads. See Figure A in the Appendix. Consistent with estimates shown in Table 1, the effect of PEPP is much more pronounced than the one of PSPP.

not react to the PEPP and French (resp. Italian) spreads should increase (resp. decrease). Table D in the Appendix shows estimates of these additional tests. We find that the differentiated effects of PSPP and PEPP on spreads is at work even when excluding French and Italian bonds (so when the capital key is enforced). The differentiated effects of PSPP and PEPP holds for the two individual countries, so they are not a mechanical consequence of buying relatively more Italian bonds or relatively less French bonds. These estimates suggest that our main result is not driven by capital key deviations.

This empirical analysis suggests that the ECB communication about the rationale for each program influences the related financial market variables and may condition the effectiveness of these asset purchase programs. By providing information about which variable enters policymakers' asset purchase reaction function, the same policy instrument ends up affecting its respective intermediate objectives – inflation swaps and sovereign spreads – differently.

The mechanism behind these results may be related to the frameworks of Eusepi and Preston (2010) and Davig and Foerster (2021). Both papers discuss the extent to which central bank communication may be central in driving private expectations. Eusepi and Preston (2010) show that communicating the precise details of the monetary strategy or the variables on which central bank decisions are conditioned help anchor private expectations. Davig and Foerster (2021) show that central banks that communicate a tolerance band around their inflation target and communicate their inflation forecasts provide the same information as a rule-based policy without having to express explicitly their policy rule. Those theoretical models show that agents – here financial market participants – extract information from central bank communication. By communicating on the intermediate objectives underlying its policy decisions, the central bank makes sure that private agents become aware of the variables entering its reaction function. The present event-study analysis suggests that the policymakers' signals are well received by financial market participants.

4. The effect of asset purchase flows

Beyond policy announcements, weekly purchase flows may provide additional information on how the central bank accounts for the financial and macroeconomic environment and notably how it reacts to deviations of its intermediate objectives. PSPP and PEPP weekly purchase flows display a similar variability and may adjust to inflation swaps and sovereign stress. For instance, an increase in PEPP purchases could indicate the ECB willpower to further reduce spreads. Figure 3 shows 4-week cumulated PSPP and PEPP purchase flows. The latter amounted to €50 bn at the launch of the program and reached a peak above €115 bn by the end of May 2021. Once sovereign stress attenuated, purchases declined and amounted to €75 bn in March 2021. The monthly target of PSPP purchases has been adjusted on several occasions since 2015, and weekly flows exhibit a similar degree of variability.

In what follows, we make use of the fluctuations in PSPP and PEPP flows to assess the dynamic effects of the PSPP and PEPP on their intermediate objectives. This complementary empirical approach enables us to address the concern that policy announcement effects may be short-lived and rely on a signaling channel only. PSPP and PEPP purchase flows provide information to investors on how the central bank reacts to the financial and macroeconomic environment and help investors infer the parameters of the central bank reaction function. This mechanism relies on the fact that the information embedded in purchase flows is scrutinized by ECB watchers. As an anecdotal evidence, the tweet from Frederik Ducrozet at Pictet Wealth Management on 17 May 2021 suggests that it may indeed be the case ("PEPP purchases slightly

higher than normal. Like it or not, markets will continue to focus on weekly PEPP purchases as peripheral bond yields move higher").

We use weekly information released by the ECB on the outstanding amounts of public securities held within the PSPP and PEPP. Because the ECB may adjust weekly purchases to the dynamics of inflation swaps and sovereign spreads, there is a potential endogeneity issue such that we cannot directly test the effect of weekly purchases on these two variables. To circumvent this reverse causality, we follow a two-step approach. We first estimate the relationship between weekly purchases and lagged inflation swaps and sovereign stress.[24] We then use the residuals from this first-stage equation in a second-stage equation to assess the impact of exogenous variations in purchase flows on contemporaneous and future inflation swaps and sovereign spreads.

Because the ECB could relate its purchases to contemporaneous dynamics in inflation swaps and sovereign spreads, we use some timing features of the data to circumvent this issue. ECB purchase flows are the sum of all purchases during a given week, whereas asset prices are end-of-week values (in contrast to week-average values).[25] Therefore, within a given period (i.e. week), asset purchase flows cannot respond to contemporaneous inflation swaps and sovereign spreads by construction. Weekly asset purchase flows are driven by inflation swaps and sovereign spread dynamics that occurred up to the last day of the previous week.

The first-stage equation consists in purging the endogenous response of PEPP and PSPP flows for their main potential determinants. We estimate the following two equations:

$$pspp_t = \alpha + \sum_i \rho_i pspp_{t-i} + \sum_i \delta_{1i} pca1_{t-i} + \sum_i \delta_{2i} pca2_{t-i} + \sum_j \phi_i \pi^e_{t-i} + \theta Z_t + \epsilon^{pspp}_t \quad (3)$$

$$pepp_t = \alpha' + \sum_i \rho'_i pepp_{t-i} + \sum_i \delta'_{1i} pca1_{t-i} + \sum_i \delta'_{2i} pca2_{t-i} + \sum_j \phi'_i \pi^e_{t-i} + \theta' Z_t + \epsilon^{pepp}_t \quad (4)$$

where $pspp_t$ and $pepp_t$ are weekly purchase flows for both programs. We compute the first ($pca1$) and second ($pca2$) principal components of 10 euro area sovereign spreads.[26] We also include 5-year 5-year-forward inflation swaps (π^e_t). We consider purchases during a week t against inflation expectations and sovereign spreads in the previous two weeks (so i = 2). Inflation swaps and sovereign spreads are considered at their end-of-week values. We include financial market volatility (VSTOXX) to control for changing market conditions, Scotti (2016)'s macroeconomic news surprise index and the (month-over-month) inflation rate to control for the endogenous policy response of a standard central bank reaction function.[27] Equation (3) for PSPP flows is estimated from March 2015 (week 14) to March 2021 (week 12), while Equation (4) for PEPP flows is estimated from April 2020 (week 15) to March 2021 (week 12). Residuals of both equations (shown in Figure B in the Appendix) represent our exogenous variations in PSPP and PEPP flows.

In the second-stage equation, we estimate the effects of the first-stage equation residuals on inflation expectations and sovereign spreads. As for the event-study, we consider the following null hypotheses: we expect PSPP flows to influence inflation expectations (H1: $\beta_{pspp} > 0$) and PEPP flows to affect negatively sovereign spreads (H2: $\gamma_{pepp} < 0$). Equation

[24] See Blot et al. (2020) for a similar procedure.

[25] This timing feature is similar in spirit to timing restrictions that govern the VAR Cholesky-decomposition.

[26] The first two principal components have eigenvalues above one and explain 75% of the variance (51% and 24% respectively). Alternative specifications (including the ECB's sovereign CISS) provide similar estimates in the second-stage equation. See Table E in the Appendix.

[27] Alternative specifications (excluding the set of controls or considering these controls with a lag) provide similar estimates in the second-stage equation (see Tables F and G in the Appendix).

(5) for PSPP flows is estimated from March 2015 to March 2021, while Equation (6) for PEPP flows is estimated from April 2020 to March 2021:

$$Y_{t+h} = \alpha + \rho Y_{t-1} + \beta_{pspp}\epsilon_t^{pspp} + \theta Z_t + \mu_t \quad (5)$$

$$Y_{t+h} = \alpha' + \rho' Y_{t-1} + \gamma_{pepp}\epsilon_t^{pepp} + \theta' Z_t + \mu_t' \quad (6)$$

where Y_{t+h} is either 5-year 5-year-forward inflation swaps or the first principal component of the same 10 euro area sovereign spreads with Germany.[28] To capture the dynamic effects of PEPP and PSPP, both equations are estimated for $h = \{0,...,3\}$. The vector Z_t includes a lag of the gross purchase flows of the considered program, financial market volatility (VSTOXX), Scotti (2016)'s macroeconomic news surprise index, and US monetary policy surprises (measured as the daily change in US nominal 2-year interest rates on the day of FOMC announcements). The inclusion of US monetary surprises aims to control for global spillover effects of US monetary policy (Degasperi et al., 2021). In the PEPP equation (6), because PSPP and PEPP purchases happen side-by-side, we also include PSPP residuals as an additional control in the vector Z_t. Both equations are estimated with OLS and heteroskedasticity-robust standard errors. Both dependent variables and PSPP and PEPP residuals have been normalized to a unit standard deviation so the effects can be compared.
Table 2 provides evidence of the same pattern as in the event-study. PSPP flows have a positive effect on inflation swaps, whereas they have no significant effect on sovereign spreads. The PSPP effect on inflation expectations increases with time, such that a 1-standard-deviation (SD) exogenous increase in PSPP flows generates an increase of 0.02 SD during the contemporaneous week up to 0.04 SD after 3 weeks. In economic terms, this is equivalent to a 1% increase in PSPP flows generating a 2 bp increase in inflation swaps. At the opposite, we find that PEPP flows do not affect inflation swaps but have a negative and significant effect on sovereign spreads. A 1-SD increase in PEPP flows reduces the first principal component of euro area spreads by 0.07 SD in the contemporaneous week, with a trough at -0.11 SD in the week after, and then a decrease of 0.09 SD in the second week.[29] In economic terms, a 1% increase in PEPP flows yields a 2.5 bp decrease in sovereign spreads.

We explore again the possibility that our estimates reflect differences in capital key deviations between the PSPP and PEPP rather than in rationales. We estimate, based on equations (5) and (6) the PSPP and PEPP effects on the same four measures of spread as in section 3. Table D in the Appendix shows estimates of these additional tests. We find that the differentiated effects of PSPP and PEPP on spreads is at work when excluding French and Italian bonds (so when the capital key is enforced) and for the two individual countries (so the differentiated effect is not a mechanical consequence of buying more Italian bonds, and all the more so that it is at work too for French bonds that were underpurchased). These estimates suggest that our main result is not driven by capital key deviations.

Because the resurgence of sovereign stress in 2020 is strongly related to the spread of the Covid-19 pandemic and because this shock was asymmetric in its magnitude and timing, we control that our estimated effects are not related to the number of Covid-19 deaths in euro area countries. Ortmans and Tripier (2021) show that the increase in sovereign spreads was directly related to Covid-19 deaths in euro area countries. We have tested an alternative specification with Covid-19 deaths as a control to isolate the effects of PSPP and PEPP alone on inflation swaps and sovereign spreads. Our main findings are unchanged (see Table I in the Appendix).

[28] Table C in the Appendix shows the eigenvalues of the principal component analysis of the 10 weekly series. We also show that our results are similar if we use the mean of sovereign spreads (see Table H in the Appendix).
[29] Estimates for PSPP and PEPP effects are homogeneous across individual countries (see Figure C in the Appendix).

Finally, because PEPP estimates rely on a relatively limited sample, we assess whether the differentiated result with PSPP estimates does not arise from the longer sample observed for the latter. We therefore estimates the effects of PSPP flows on a similar sample than for the PEPP: we restrict the estimation to the first 49 observations. In addition, we also estimate a specification where we remove the third most extreme values for both dependent variables and both PSPP and PEPP residuals in order to ensure that our results are not driven by outliers in our four series of interest. Estimates for both tests show that our main findings are robust (see Table J in the Appendix).

Our results document an original pattern in the transmission of ECB asset purchases. PSPP and PEPP purchase flows have opposite effects on the two variables identified as their intermediate objectives. PSPP influences inflation expectations and PEPP affects sovereign spreads, but we find no evidence of the opposite. Our empirical analysis suggests that the information conveyed by purchase flows for each program matters for the effectiveness of both asset purchase programs. These purchase flows could thus provide signals to investors about the relevant parameters in the central bank asset purchase reaction function. The same policy instrument, by shaping investors' beliefs about policymakers' preferences, affects its respective intermediate objectives – inflation expectations and sovereign spreads – in a different manner.

5. Conclusion

In this paper, we investigate whether similar asset purchases from two different programs may produce different financial market effects according to their respective rationales. Hence, the paper aims at exploring whether the central bank rationale for using a given instrument matters for the transmission of monetary policy. To answer this question, we exploit the unique setting of ECB asset purchases: the PSPP was introduced in 2015 to counter deflationary risks, while the PEPP was introduced in 2020 to counter sovereign risks.

We use two complementary approaches (an event-study focusing on announcement effects and a flow analysis focusing on implementation effects) and document an original pattern of monetary policy. The main result of this paper is that the PSPP and PEPP are not substitutes. We find that two otherwise similar asset purchase policies may have different financial market effects, if policymakers have highlighted that these policies pursue different intermediate objectives. We find that PSPP purchase flows positively affect inflation expectations but PEPP flows do not, whereas PEPP purchase flows negatively affect sovereign spreads and PSPP flows do not. The main policy implication of this paper is that communicating explicitly a rationale for a policy is crucial in determining the effects of that policy on its intermediate objectives.

Another related implication refers to the benefit of using asset purchases as an instrument for implementing monetary policy. Two different programs of asset purchases can be implemented at the same time with different objectives whereas this is not the case for the interest rate instrument. Our results suggest that central banks could make use of this additional flexibility to achieve their objectives.

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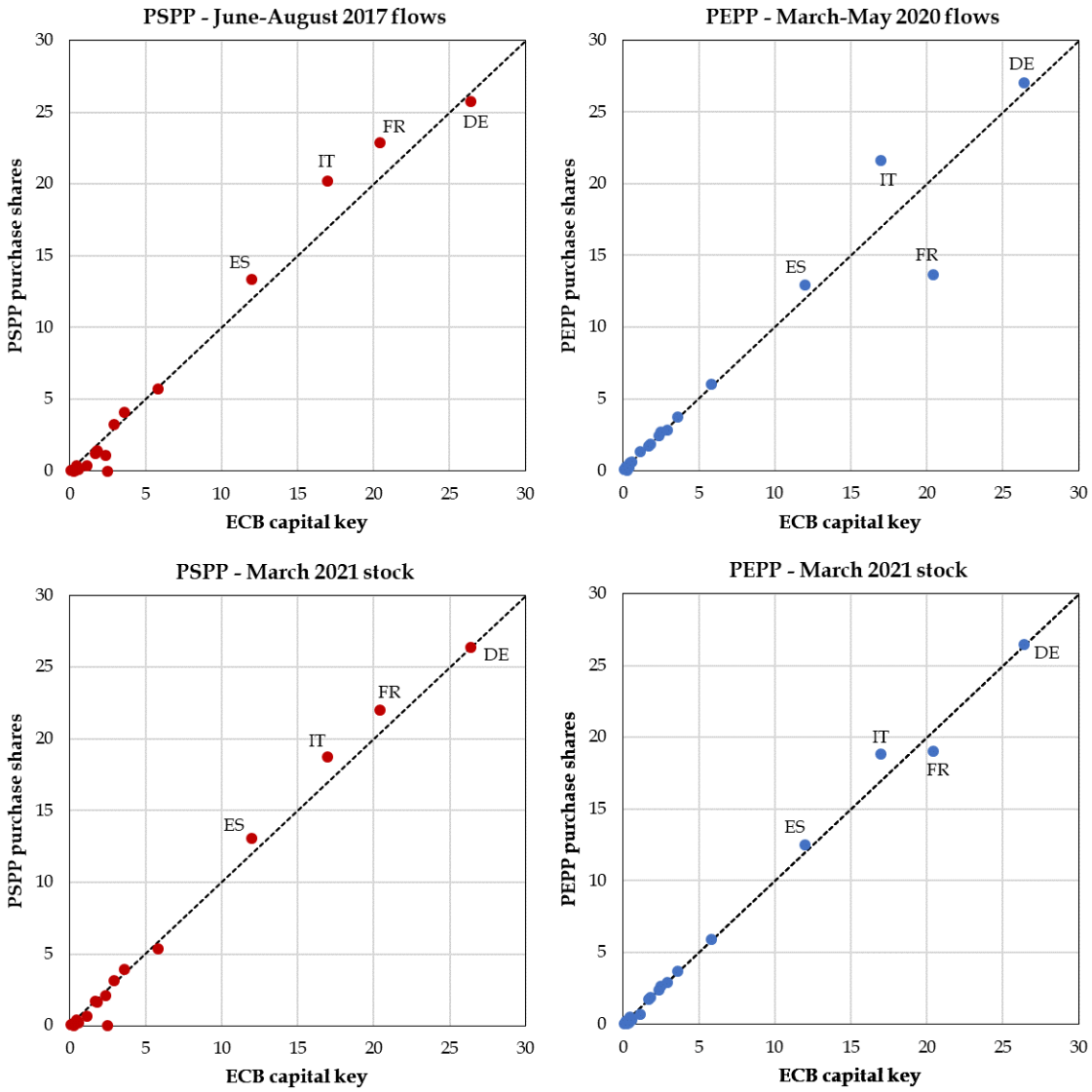
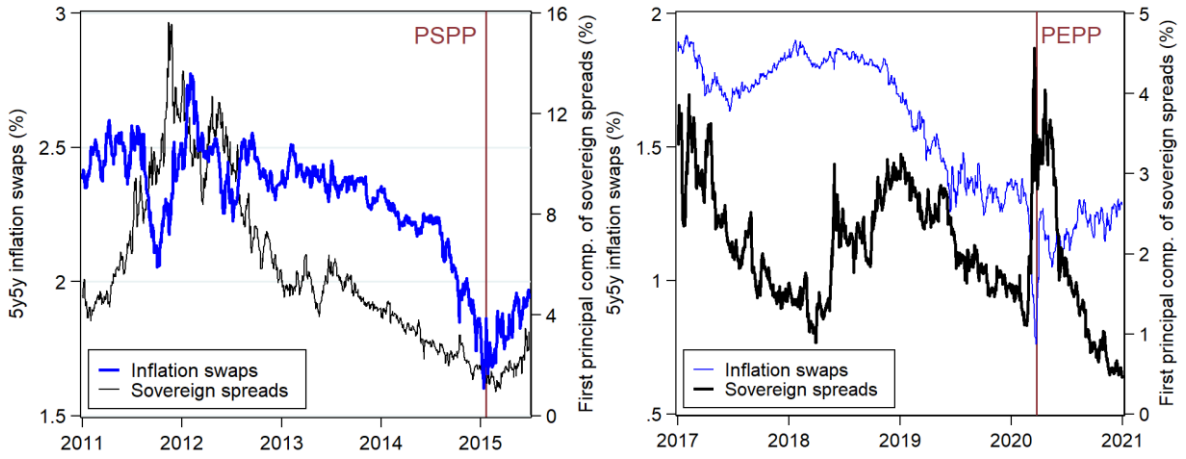
Figure 1 – PSPP and PEPP capital key deviations



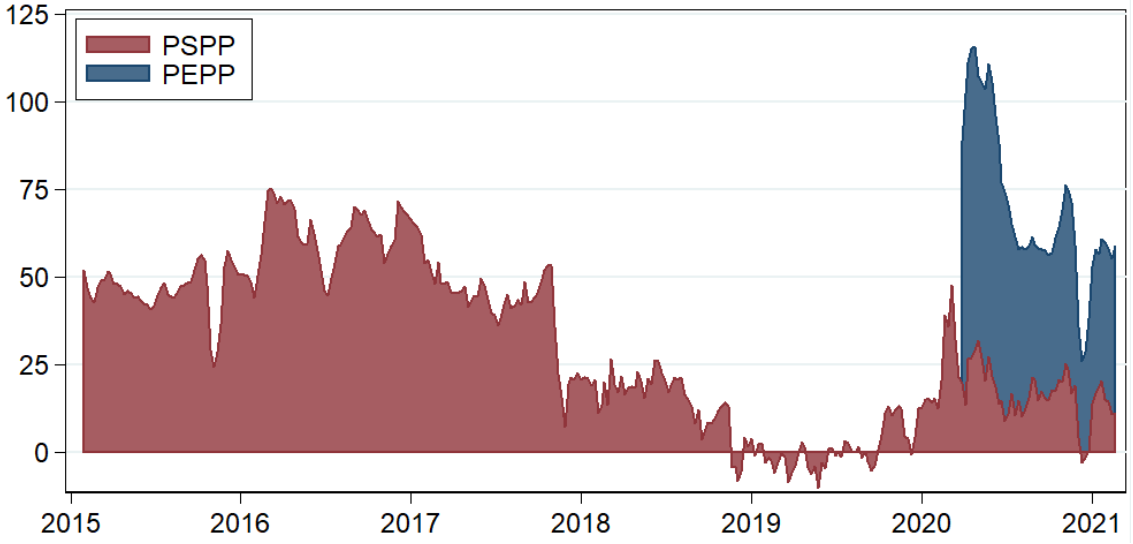
Note: Left-hand side panels show how actual PSPP purchase shares compare to the ECB capital key, while right-hand side panels show how actual PEPP purchase shares compare to the ECB capital key. On the upper row, 3-month flows are considered while the bottom row plots purchase stocks as of March 2021. Source: https://www.ecb.europa.eu/mopo/implement/pepp for the history of 3-month PEPP purchase breakdowns and https://www.ecb.europa.eu/mopo/implement/app for the history of monthly PSPP purchase breakdowns.

Figure 2 – Inflation expectations and sovereign spreads around policy implementations



Note: Both panels show the evolution of 5-year 5-year-forward inflation swaps (blue line) and the first principal component of 10 euro area sovereign spreads relative to Germany (black line) in the years around the PSPP implementation (left panel) and around the PEPP implementation (right panel). The first principal component is rescaled to the interest rate space for sake of simplicity. Source: Datastream.

Figure 3 - PSPP and PEPP cumulated flows of asset purchases



Note: The graph shows the flows of asset purchases in €bn, cumulated over 4 weeks. Source: ECB.

Table 1 – PSPP and PEPP announcement effects on inflation swaps and sovereign spreads

Inflation swaps								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Baseline	10-year	Surprises	Liquidity	PSPP_Ext	Daily MPS	1st Ann.	Normaliz.
	Swap5y5y	Swap10y	Swap5y5y	Swap5y5y	Swap5y5y	Swap5y5y	Swap5y5y	Swap5y5y
PSPP	1.580**	1.347**	1.626***	1.584**	2.189***	1.509**	3.408***	1.312**
	[2.49]	[2.02]	[2.65]	[2.51]	[3.11]	[2.32]	[26.83]	[2.50]
PEPP	0.096	-0.176	-0.758	-0.096	0.141	0.086	-1.624***	-0.400
	[0.08]	[-0.14]	[-0.87]	[-0.07]	[0.12]	[0.07]	[-6.34]	[-0.46]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	123	123	123	123	123	123	123	120
R2	0.12	0.16	0.16	0.12	0.14	0.13	0.12	0.10
Sovereign spreads								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Baseline	Mean	Surprises	Liquidity	PSPP_Ext	Daily MPS	1st Ann.	Normaliz.
	PCA_spd	Mean_spd	PCA_spd	PCA_spd	PCA_spd	PCA_spd	PCA_spd	PCA_spd
PSPP	-0.752**	-0.899***	-0.742**	-0.750**	-0.876**	-0.649**	-0.166	-0.831**
	[-2.37]	[-3.72]	[-2.41]	[-2.35]	[-2.04]	[-2.11]	[-1.31]	[-2.14]
PEPP	-1.863**	-2.024*	-2.043**	-1.960**	-1.872**	-1.847**	-4.031***	-1.085**
	[-2.36]	[-1.91]	[-2.20]	[-2.41]	[-2.38]	[-2.33]	[-13.11]	[-2.38]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	123	123	123	123	123	123	123	120
R2	0.40	0.34	0.40	0.40	0.40	0.41	0.41	0.33

Note: t-statistics in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01. Parameters are estimated from Equation (1) for inflation swaps and Equation (2) for sovereign spreads with OLS using Huber-White heteroskedasticity-robust standard errors. The dependent variable is the daily change in 5-year 5-year forward inflation swaps in the upper panel and the first principal component of 10-year sovereign spreads with Germany for 10 euro area countries (Italy, Spain, Portugal, Greece, Ireland, France, Netherlands, Belgium, Austria and Finland) in the bottom panel. The constant being null has been removed from the table. The parameters for the control variables have also been removed for parsimony and are available from the authors upon request. Column (1) is the baseline estimation. In Column (2), the dependent variable is replaced with 10-year inflation swaps (upper panel) and the mean of the 10 sovereign spreads (bottom panel). In column (3), we include Scotti (2016)'s macroeconomic surprises as an additional control. In column (4), we control for liquidity provision announcements. In column (5), we control for announcements of the extension of the period during which asset purchases will be conducted. In column (6), we replace intraday monetary surprises by daily monetary surprises. In column (7), the PSPP and PEPP dummies are replaced by dummies for the first announcement of each program, so 22 January 2015 for the PSPP and 19 March 2020 for the PEPP. In column (8), we compute the standard deviation (SD) of daily changes in inflation swaps and spreads over a rolling-window of 50 business days and normalize the daily change in swaps and spreads at each ECB announcement by its respective SD in the recent past.

Table 2 –PSPP and PEPP flow effects on inflation expectations and sovereign spreads

	Swap5y5y				PCA_spd			
	t	**t+1**	**t+2**	**t+3**	**t**	**t+1**	**t+2**	**t+3**
PSPP flows over 2015 - 2021								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ϵ_{PSPP}	0.021**	0.026**	0.038***	0.042**	-0.004	-0.027	-0.008	-0.025
	[2.27]	[2.31]	[2.76]	[2.59]	[-0.21]	[-1.44]	[-0.39]	[-0.91]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	312	311	310	309	312	311	310	309
R2	0.97	0.94	0.92	0.89	0.89	0.82	0.74	0.69
PEPP flows over 2020 - 2021								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ϵ_{PEPP}	0.032	0.056	0.062	0.043	-0.073**	-0.109**	-0.093*	-0.080
	[0.92]	[1.17]	[1.35]	[0.87]	[-2.04]	[-2.17]	[-1.84]	[-1.35]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	49	48	47	46	49	48	47	46
R2	0.94	0.88	0.84	0.82	0.98	0.97	0.95	0.93

Note: t-statistics in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Parameters are estimated from Equation (5) for the effect of PSPP flows (upper panel) and Equation (6) for the effect of PEPP flows (bottom panel) with OLS using Huber-White heteroskedasticity-robust standard errors. The dependent variable is the daily change in 5-year 5-year forward inflation swaps in columns (1) to (4) and the first principal component of 10-year sovereign spreads with Germany for 10 euro area countries (Italy, Spain, Portugal, Greece, Ireland, France, Netherlands, Belgium, Austria and Finland) in columns (5) to (8). PSPP residuals are estimated from Equation (3) while PEPP residuals are estimated from Equation (4). The constant and parameters for the control variables have also been removed for parsimony and are available from the authors upon request. The effect of PSPP (or PEPP) is estimated contemporaneously and over the following 3 weeks. The sample for the upper panel starts in March 2015 (week 14) and the one for the bottom panel starts in April 2020 (week 15). They both end in March 2021 (week 10).

APPENDIX

A. Press articles

The ECB will do everything necessary to counter the virus
Christine Lagarde, ECB President
Financial Times - 19 March 2020
https://www.ft.com/content/281d600c-69f8-11ea-a6ac-9122541af204

"Risk-free rates have moved up and government bond yields — benchmarks that are key to the pricing of all assets — have increased everywhere and become more dispersed. These developments impair the smooth transmission of our monetary policy across the euro area and put price stability at risk."

"As a result, the European Central Bank's governing council has created a new Pandemic Emergency Purchase Programme of up to €750bn until the end of the year on top of the €120b in extra purchases announced on March 12."

ECB to launch €750bn bond-buying programme
Financial Times - 19 March 2020
https://www.ft.com/content/711c5df2-695e-11ea-800d-da70cff6e4d3

"The move brought an instant rebound in European debt markets, boosting the price of sovereign bonds from Italy to Germany, which had been under pressure from investors selling assets in response to fears about the pandemic."

"The yield on Italian 10-year bonds dropped 106 basis points to 1.37 per cent — almost halving the Italian government's financing costs, and soothing fears that investors could test the ECB's ability to backstop the debts of peripheral nations."

"Economists have been calling for the ECB to increase its bond-buying programme, which has already collected €2.6tn of assets, particularly since the borrowing costs of southern eurozone countries — including Italy and Greece — began rising sharply to levels not seen for more than a year."

"Ms Lagarde was also forced to beat a hasty retreat and to issue an apology to the rest of the council last week after she said it was not the ECB's role to "close the spread" in sovereign debt markets — referring to the gap between Italian and German bond yields that is a key risk indicator for Italy. That triggered a bond market sell-off, pushing up Italian government bond yields."

ECB to Buy Bonds to Combat Economic Slowdown From Coronavirus
Wall Street Journal - 19 March 2020
https://www.wsj.com/articles/ecb-seeks-to-mend-rifts-as-economic-clouds-gather-11584523534

"The European Central Bank unveiled a new €750 billion ($818.7 billion) bond-buying program aimed at shielding the eurozone economy from the spreading coronavirus, casting aside longstanding taboos to send a determined signal to investors that the bank will stand behind the region's embattled governments."

"The decision came during an unscheduled late-night conference call among top ECB officials, on a day when borrowing costs for governments like Italy and Spain jumped as the virus roiled and shuttered the region."

"Last Thursday, ECB President Christine Lagarde stressed at a news conference that the bank was "not here to close spreads," suggesting it wouldn't intervene to narrow the difference in borrowing costs between Germany and Italy."

ECB to print 1 trillion euro this year to stem coronavirus rout
Reuters – 19 March 2020
https://www.reuters.com/article/us-health-coronavirus-ecb-idUSKBN21543D

"The European Central Bank launched 750 billion euro emergency bond purchase scheme in a bid to stop a pandemic-induced financial rout from shredding the euro zone's economy and raising fresh concerns about the currency bloc's viability."

"Although global stocks continued to fall after the ECB's move, the euro held broadly steady and bond yields in the bloc's periphery tumbled, with Italy leading the way with a 90 basis point drop on its 10-year benchmark."

"Although it will still buy government bonds according to each country's shareholding in the bank, the so-called capital key, the ECB said it would be flexible and may deviate from this rule."

"This was seen as a clear indication that it will not tolerate the surge in yield spreads between euro zone members seen in Italy and Greece in recent days."

B. Additional figures and tables

Table A – The PSPP and PEPP announcements

	Asset purchases	
	PSPP	PEPP
22 January 2015	Announcement of the expanded asset purchase program including public securities (PSPP). Monthly purchases of EUR 60 billion until September 2016	
10 March 2016	Increase of monthly purchases by EUR 20 billion and expanded until December 2017	
8 December 2016	Reduction of monthly purchases by EUR 20 billion	
26 October 2017	Reduction of monthly purchases by EUR 30 billion and expanded until September 2018	
14 June 2018	Reduction of monthly purchases by EUR 15 billion and expanded until December 2018	
12 September 2019	Restart of monthly purchases by EUR 20 billion	
12 March 2020	Additional EUR 120 billion envelope until December 2020	
18 March 2020 *		Announcement of the PEPP with a total envelope of EUR 750 billion until December 2020
4 June 2020		Increase and extended deadline for the envelope: EUR 600 billion until June 2021
10 December 2020		Increase and extended deadline for the envelope: EUR 500 billion until March 2022

Note: The objective for monthly purchases is for all programs included in the APP. However, it may be mainly considered as a PSPP announcement as purchases of public securities represent the bulk of asset purchases. The dummy variable used for the estimation corresponds to the date at which the program has been announced for the first time. Modalities may be clarified during the following meeting and effective purchases may start a few weeks later. * The impact on financial markets is yet assessed on the 19 March since the press release was communicated late in the evening.

Table B – Other policy announcements

	TLTRO	Liquidity	Other asset purchase decisions
7 May 2009			CBPP I announcement
10 May 2011			SMP announcement
6 October 2011			CBPP II announcement
6 September 2012			OMT announcement
5 June 2014	Announcement of a series of Targeted longer term refinancing operations		
4 September 2014			ABSPP and CBPP III announcement
10 March 2016	Announcement of a new series of Targeted longer term refinancing operations		APP now includes purchase of corporate sector securities (CSPP)
7 March 2019	Announcement of a new series of Targeted longer term refinancing operations		
12 March 2020		Additional Longer term refinancing operations	
30 April 2020		Announcement of special refinancing operations for the pandemic (PELTRO)	
10 December 2020		Additional PELTRO	

Note: The dummy variable used for the estimation corresponds to the date at which the programme has been announced for the first time. Modalities may be clarified during the following meeting and effective purchase may start a few weeks later.

Table C – Principal Component Analysis

Event-study analysis			
N	3189	Variables	10
	Eigenvalue	Proportion	Cumulative
Comp1	7.18	0.72	0.72
Comp2	1.38	0.14	0.86
Comp3	0.52	0.05	0.91
Flow analysis			
N	324	Variables	10
	Eigenvalue	Proportion	Cumulative
Comp1	5.16	0.52	0.52
Comp2	2.39	0.24	0.75
Comp3	0.84	0.08	0.83

Table D – Exploring the role of capital key deviations

Event-study analysis				
	PCA ex. FR/IT	Mean ex. FR/IT	spd_IT	spd_FR
PSPP	-0.722**	-0.844***	-0.897***	-0.458
	[-2.26]	[-3.23]	[-3.09]	[-1.00]
PEPP	-1.830**	-1.870*	-2.206**	-1.048**
	[-2.24]	[-1.80]	[-2.47]	[-2.61]
Controls	Yes	Yes	Yes	Yes
N	123	123	123	123
R2	0.34	0.27	0.53	0.34
Flow analysis				
	PCA ex. FR/IT	Mean ex. FR/IT	spd_IT	spd_FR
ϵ_{PSPP}	-0.003	0.013	0.009	-0.006
	[-0.15]	[0.81]	[0.65]	[-0.44]
Controls	Yes	Yes	Yes	Yes
N	312	312	312	312
R2	0.91	0.97	0.94	0.88
ϵ_{PEPP}	-0.067**	-0.023*	-0.053*	-0.072*
	[-2.13]	[-1.75]	[-1.99]	[-1.69]
Controls	Yes	Yes	Yes	Yes
N	49	49	49	49
R2	0.98	0.98	0.98	0.96

Note: t-statistics in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Parameters are estimated from Equation (2) in the upper panel and from Equation (5) for the effect of PSPP flows and Equation (6) for the effect of PEPP flows in the bottom panel, with OLS using Huber-White heteroskedasticity-robust standard errors. The dependent variable is the first principal component of 10-year sovereign spreads with Germany excluding France and Italy, so for 8 euro area countries (Spain, Portugal, Greece, Ireland, Netherlands, Belgium, Austria and Finland) in column (1), the mean of 10-year sovereign spreads with Germany over the same 8 countries in column (2), the Italian 10-year sovereign spread in column (3) and the French 10-year sovereign spread in column (4). In the bottom panel, PSPP residuals are estimated from Equation (3) while PEPP residuals are estimated from Equation (4). The effect of PSPP (or PEPP) is estimated contemporaneously. The sample for the upper panel starts in March 2015 (week 14) and the one for the bottom panel starts in April 2020 (week 15). They both end in March 2021 (week 10). In both panels, the constant and parameters for the control variables have also been removed for parsimony and are available from the authors upon request.

Table E – Including the Sovereign CISS in the first-stage equation

	Swap5y5y				PCA_spd			
	t	**t+1**	**t+2**	**t+3**	**t**	**t+1**	**t+2**	**t+3**
ϵ_{PSPP}	0.021**	0.028**	0.043***	0.046***	-0.007	-0.031	-0.011	-0.023
	[2.17]	[2.34]	[2.97]	[2.79]	[-0.38]	[-1.61]	[-0.52]	[-0.84]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	312	311	310	309	312	311	310	309
R2	0.97	0.94	0.92	0.89	0.89	0.82	0.74	0.69
ϵ_{PEPP}	0.037	0.055	0.055	0.057	-0.089**	-0.113**	-0.086**	-0.074
	[1.17]	[1.24]	[1.22]	[1.10]	[-2.58]	[-2.39]	[-2.03]	[-1.26]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	49	48	47	46	49	48	47	46
R2	0.94	0.88	0.84	0.83	0.98	0.97	0.95	0.93

Note: t-statistics in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01. Parameters are estimated from Equation (5) for the effect of PSPP flows (upper panel) and Equation (6) for the effect of PEPP flows (bottom panel) with OLS using Huber-White heteroskedasticity-robust standard errors. The dependent variable is the daily change in 5-year 5-year forward inflation swaps in columns (1) to (4) and the first principal component of 10-year sovereign spreads with Germany for 10 euro area countries (Italy, Spain, Portugal, Greece, Ireland, France, Netherlands, Belgium, Austria and Finland) in columns (5) to (8). PSPP residuals are estimated from Equation (3) while PEPP residuals are estimated from Equation (4). These 2 equations are augmented with the Sovereign CISS measure published by the ECB. The constant and parameters for the control variables have also been removed for parsimony and are available from the authors upon request. The effect of PSPP (or PEPP) is estimated contemporaneously and over the following 3 weeks. The sample for the upper panel starts in March 2015 (week 14) and the one for the bottom panel starts in April 2020 (week 15). They both end in March 2021 (week 10).

Table F – Removing macroeconomic controls in the first-stage equation

	Swap5y5y				PCA_spd			
	t	**t+1**	**t+2**	**t+3**	**t**	**t+1**	**t+2**	**t+3**
ϵ_{PSPP}	0.024***	0.033***	0.046***	0.052***	-0.006	-0.030	-0.010	-0.027
	[2.66]	[2.87]	[3.42]	[3.13]	[-0.33]	[-1.57]	[-0.46]	[-0.99]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	312	311	310	309	312	311	310	309
R2	0.97	0.94	0.92	0.89	0.89	0.82	0.74	0.69
ϵ_{PEPP}	0.035	0.061	0.058	0.027	-0.074*	-0.113**	-0.082	-0.053
	[0.99]	[1.24]	[1.13]	[0.47]	[-1.95]	[-2.20]	[-1.54]	[-0.68]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	49	48	47	46	49	48	47	46
R2	0.94	0.88	0.84	0.83	0.98	0.97	0.95	0.93

Note: t-statistics in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Parameters are estimated from Equation (5) for the effect of PSPP flows (upper panel) and Equation (6) for the effect of PEPP flows (bottom panel) with OLS using Huber-White heteroskedasticity-robust standard errors. The dependent variable is the daily change in 5-year 5-year forward inflation swaps in columns (1) to (4) and the first principal component of 10-year sovereign spreads with Germany for 10 euro area countries (Italy, Spain, Portugal, Greece, Ireland, France, Netherlands, Belgium, Austria and Finland) in columns (5) to (8). PSPP residuals are estimated from Equation (3) while PEPP residuals are estimated from Equation (4). In these 2 equations, the financial and macroeconomic controls have been removed. The constant and parameters for the control variables have also been removed for parsimony and are available from the authors upon request. The effect of PSPP (or PEPP) is estimated contemporaneously and over the following 3 weeks. The sample for the upper panel starts in March 2015 (week 14) and the one for the bottom panel starts in April 2020 (week 15). They both end in March 2021 (week 10).

Table G – Considering macroeconomic controls with a lag in the first-stage equation

	Swap5y5y				PCA_spd			
	t	**t+1**	**t+2**	**t+3**	**t**	**t+1**	**t+2**	**t+3**
ϵ_{PSPP}	0.021**	0.027**	0.038***	0.043***	-0.005	-0.029	-0.012	-0.027
	[2.32]	[2.36]	[2.74]	[2.64]	[-0.29]	[-1.47]	[-0.55]	[-1.01]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	312	311	310	309	312	311	310	309
R2	0.97	0.94	0.92	0.89	0.89	0.82	0.74	0.69
ϵ_{PEPP}	0.04	0.059	0.055	0.026	-0.081**	-0.100**	-0.092*	-0.068
	[1.13]	[1.21]	[1.17]	[0.49]	[-2.28]	[-2.32]	[-1.78]	[-1.04]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	49	48	47	46	49	48	47	46
R2	0.94	0.88	0.84	0.82	0.98	0.97	0.95	0.93

Note: t-statistics in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Parameters are estimated from Equation (5) for the effect of PSPP flows (upper panel) and Equation (6) for the effect of PEPP flows (bottom panel) with OLS using Huber-White heteroskedasticity-robust standard errors. The dependent variable is the daily change in 5-year 5-year forward inflation swaps in columns (1) to (4) and the first principal component of 10-year sovereign spreads with Germany for 10 euro area countries (Italy, Spain, Portugal, Greece, Ireland, France, Netherlands, Belgium, Austria and Finland) in columns (5) to (8). PSPP residuals are estimated from Equation (3) while PEPP residuals are estimated from Equation (4). In these two equations, the financial and macroeconomic controls are considered with a lag rather than contemporaneously. The constant and parameters for the control variables have also been removed for parsimony and are available from the authors upon request. The effect of PSPP (or PEPP) is estimated contemporaneously and over the following 3 weeks. The sample for the upper panel starts in March 2015 (week 14) and the one for the bottom panel starts in April 2020 (week 15). They both end in March 2021 (week 10).

Table H – Alternative measure (mean) of sovereign spreads

	Mean_spd			
	t	**t+1**	**t+2**	**t+3**
ϵ_{PSPP}	0.014	-0.007	-0.004	-0.027
	[0.78]	[-0.36]	[-0.22]	[-1.31]
Controls	Yes	Yes	Yes	Yes
N	312	311	310	309
R2	0.96	0.94	0.91	0.89
ϵ_{PEPP}	-0.032*	-0.061**	-0.060***	-0.048*
	[-1.83]	[-2.48]	[-2.76]	[-1.80]
Controls	Yes	Yes	Yes	Yes
N	49	48	47	46
R2	0.98	0.97	0.95	0.92

Note: t-statistics in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01. Parameters are estimated from Equation (5) for the effect of PSPP flows (upper panel) and Equation (6) for the effect of PEPP flows (bottom panel) with OLS using Huber-White heteroskedasticity-robust standard errors. The dependent variable is the daily change in the mean of 10-year sovereign spreads with Germany for 10 euro area countries (Italy, Spain, Portugal, Greece, Ireland, France, Netherlands, Belgium, Austria and Finland) in columns (5) to (8). PSPP residuals are estimated from Equation (3) while PEPP residuals are estimated from Equation (4). The constant and parameters for the control variables have also been removed for parsimony and are available from the authors upon request. The effect of PSPP (or PEPP) is estimated contemporaneously and over the following 3 weeks. The sample for the upper panel starts in March 2015 (week 14) and the one for the bottom panel starts in April 2020 (week 15). They both end in March 2021 (week 10).

Table I – Controlling for Covid-19 death numbers

	Swap5y5y				PCA_spd			
	t	**t+1**	**t+2**	**t+3**	**t**	**t+1**	**t+2**	**t+3**
ϵ_{PSPP}	0.020**	0.025**	0.036***	0.040**	0.000	-0.024	-0.004	-0.019
	[2.14]	[2.14]	[2.61]	[2.44]	[-0.03]	[-1.25]	[-0.18]	[-0.71]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	312	311	310	309	312	311	310	309
R2	0.97	0.94	0.92	0.89	0.90	0.82	0.75	0.69
ϵ_{PEPP}	0.039	0.057	0.058	0.035	-0.070*	-0.095*	-0.079	-0.068
	[1.00]	[1.05]	[1.08]	[0.59]	[-1.95]	[-2.01]	[-1.59]	[-1.02]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	49	48	47	46	49	48	47	46
R2	0.94	0.88	0.84	0.83	0.98	0.97	0.96	0.94

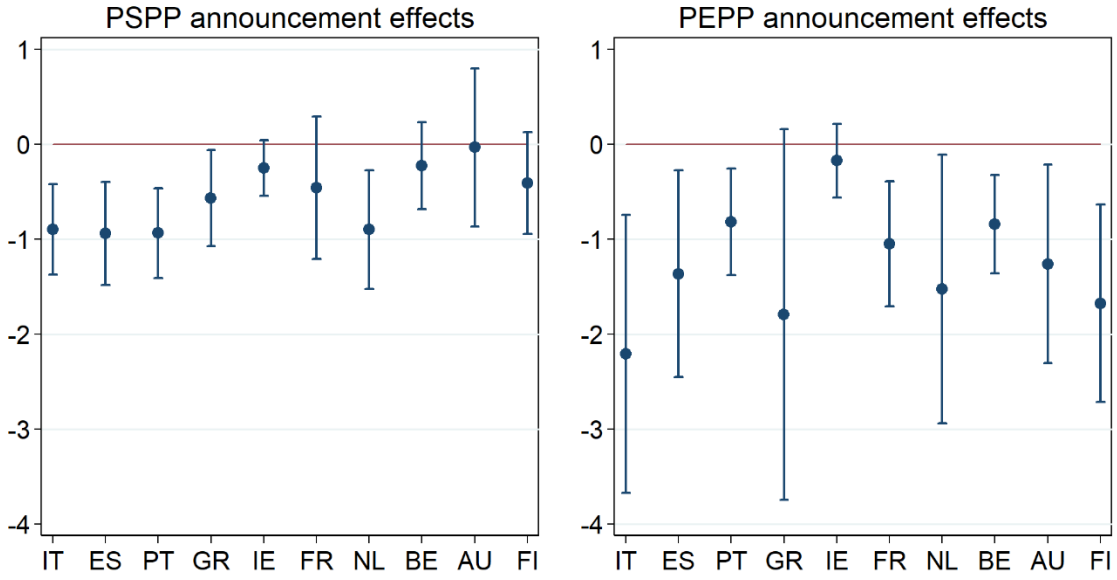
Note: t-statistics in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Parameters are estimated from Equation (5) for the effect of PSPP flows (upper panel) and Equation (6) for the effect of PEPP flows (bottom panel) with OLS using Huber-White heteroskedasticity-robust standard errors. In both equations, the daily number of Covid-19 deaths is added as a proxy measure for the strength of the Covid-19 crisis. The dependent variable is the daily change in 5-year 5-year forward inflation swaps in columns (1) to (4) and the first principal component of 10-year sovereign spreads with Germany for 10 euro area countries (Italy, Spain, Portugal, Greece, Ireland, France, Netherlands, Belgium, Austria and Finland) in columns (5) to (8). PSPP residuals are estimated from Equation (3) while PEPP residuals are estimated from Equation (4). The constant and parameters for the control variables have also been removed for parsimony and are available from the authors upon request. The effect of PSPP (or PEPP) is estimated contemporaneously and over the following 3 weeks. The sample for the upper panel starts in March 2015 (week 14) and the one for the bottom panel starts in April 2020 (week 15). They both end in March 2021 (week 10).

Table J – Alternative samples

	Swap5y5y				PCA_spd			
	t	**t+1**	**t+2**	**t+3**	**t**	**t+1**	**t+2**	**t+3**
PSPP flows over 49 observations								
ϵ_{PSPP}	0.016**	0.018*	0.028**	0.03	0.005	-0.014	0.015	-0.002
	[2.53]	[1.74]	[2.02]	[1.55]	[0.29]	[-1.11]	[0.79]	[-0.10]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	49	49	49	49	49	49	49	49
R2	0.89	0.79	0.67	0.62	0.66	0.54	0.35	0.16
Removing dependent variable and PSPP/PEPP residual outliers								
ϵ_{PSPP}	0.033**	0.034*	0.040*	0.048**	-0.020	-0.025	0.017	-0.003
	[2.32]	[1.82]	[1.80]	[2.04]	[-0.81]	[-0.80]	[0.47]	[-0.08]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	301	300	299	298	301	300	299	298
R2	0.97	0.94	0.91	0.89	0.89	0.81	0.74	0.69
ϵ_{PEPP}	0.059	0.083	0.114	0.085	-0.089**	-0.156***	-0.150*	-0.126**
	[1.06]	[1.04]	[1.68]	[1.36]	[-2.15]	[-3.17]	[-2.01]	[-2.47]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	44	43	42	41	44	43	42	41
R2	0.91	0.82	0.77	0.79	0.96	0.94	0.92	0.95

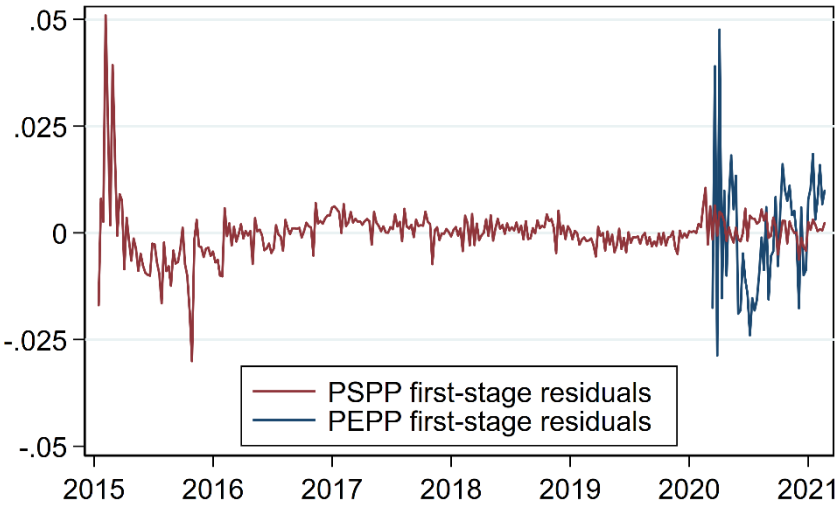
Note: t-statistics in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01. Parameters are estimated from Equation (5) for the effect of PSPP flows and Equation (6) for the effect of PEPP flows with OLS using Huber-White heteroskedasticity-robust standard errors. The dependent variable is the daily change in 5-year 5-year forward inflation swaps in columns (1) to (4) and the first principal component of 10-year sovereign spreads with Germany for 10 euro area countries (Italy, Spain, Portugal, Greece, Ireland, France, Netherlands, Belgium, Austria and Finland) in columns (5) to (8). PSPP residuals are estimated from Equation (3) while PEPP residuals are estimated from Equation (4). The constant and parameters for the control variables have also been removed for parsimony and are available from the authors upon request. The effect of PSPP (or PEPP) is estimated contemporaneously and over the following 3 weeks. The sample for the upper panel starts in March 2015 (week 14) and ends in March 2016 (week 9). In the bottom panel, the 3 largest outliers (the 3 most extreme values) for inflation swaps and sovereign spreads and for PSPP and PEPP residuals have been removed. The PSPP panel starts in March 2015 (week 14) and the PEPP panel starts in April 2020 (week 15). They both end in March 2021 (week 10).

Figure A – Announcement effects on individual sovereign spreads



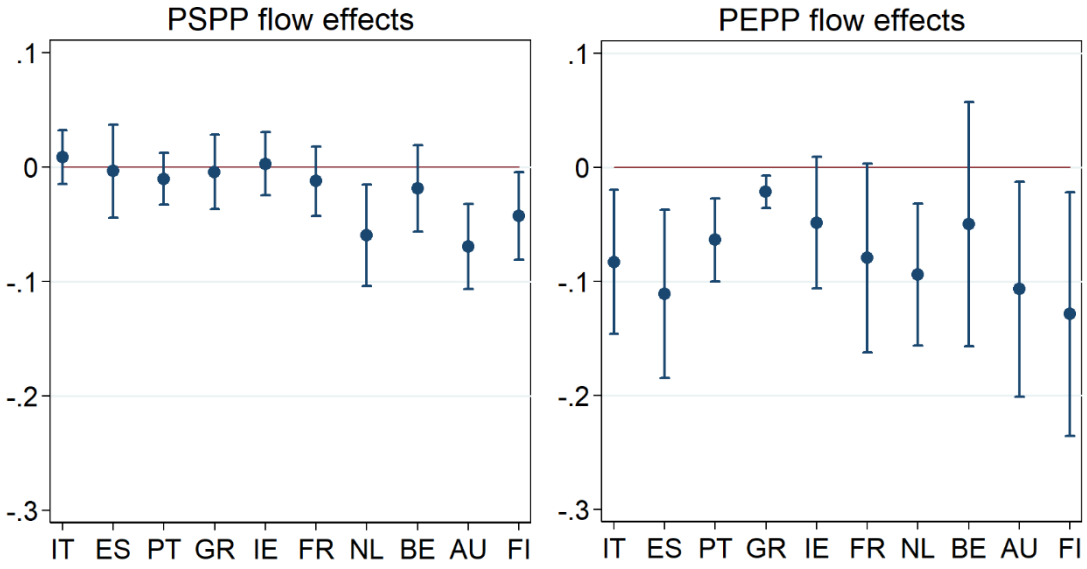
Note: The left panel shows the estimated effect -using equation (2)- of PSPP announcements on each country's sovereign spread with Germany, while the left panel shows the estimated effect -using equation (2)- of PEPP announcements on each country's sovereign spread with Germany. Bars represent a 90% confidence interval.

Figure B – First-stage residuals



Note: The figure plots the residuals of equation (3) in red for PSPP purchase flows and the residuals of equation (4) in blue for PEPP purchase flows.

Figure C – Flow effects on individual sovereign spreads



Note: The left panel shows the estimated effect -using equation (5)- of PSPP purchase flows on each country's sovereign spread with Germany in t+1, while the left panel shows the estimated effect -using equation (6)- of PEPP purchase flows on each country's sovereign spread with Germany in t+1. Bars represent a 90% confidence interval.

ABOUT OFCE

The Paris-based Observatoire français des conjonctures économiques (OFCE), or French Economic Observatory is an independent and publicly-funded centre whose activities focus on economic research, forecasting and the evaluation of public policy.

Its 1981 founding charter established it as part of the French Fondation nationale des sciences politiques (Sciences Po), and gave it the mission is to "ensure that the fruits of scientific rigour and academic independence serve the public debate about the economy". The OFCE fulfils this mission by conducting theoretical and empirical studies, taking part in international scientific networks, and assuring a regular presence in the media through close cooperation with the French and European public authorities. The work of the OFCE covers most fields of economic analysis, from macroeconomics, growth, social welfare programmes, taxation and employment policy to sustainable development, competition, innovation and regulatory affairs.

ABOUT SCIENCES PO

Sciences Po is an institution of higher education and research in the humanities and social sciences. Its work in law, economics, history, political science and sociology is pursued through ten research units and several crosscutting programmes.
Its research community includes over two hundred twenty members and three hundred fifty PhD candidates. Recognized internationally, their work covers a wide range of topics including education, democracies, urban development, globalization and public health.
One of Sciences Po's key objectives is to make a significant contribution to methodological, epistemological and theoretical advances in the humanities and social sciences. Sciences Po's mission is also to share the results of its research with the international research community, students, and more broadly, society as a whole.

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