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THE IMPACT OF UNCONVENTIONAL MONETARY POLICIES ON PERCEPTIONS OF EXTREME EVENTS AT TIMES OF CRISIS

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ABSTRACT

The European Central Bank's and the Federal Reserve's announcements of unconventional monetary policies have contributed to significantly reducing market perceptions of the probability of extreme macro-financial events. This phenomenon has arisen in periods of intense market strain, such as the global financial crisis and the current COVID-19 crisis. These measures have served to mitigate the materialisation of extremely unfavourable events through the feedback loop between the financial sector and the real economy and to ensure adequate monetary policy transmission.

Keywords: unconventional monetary policy, tail risk, uncertainty, risk-neutral densities, extreme events.

JEL classification: E44, E58, G01, G10, G14.

THE IMPACT OF UNCONVENTIONAL MONETARY POLICIES ON PERCEPTIONS OF EXTREME EVENTS AT TIMES OF CRISIS

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Introduction

In periods of crisis (such as the 2008 global financial crisis and the current COVID-19 crisis), financial markets experience bouts of high volatility during which economic agents' perceptions of the probability of extremely adverse macro-financial events increases significantly. During these episodes, this substantial uncertainty may lead to a negative spiral in the interplay between the financial sector and the real economy, and result in the materialisation of these extreme events ("tail risks").

For example, after the collapse of Lehman Brothers in September 2008, tension on global financial markets prompted a sudden reduction in their liquidity and an abrupt revaluation of financial risks, with important negative repercussions on the global financial system's stability, which contributed to accentuating the subsequent economic recession. Reducing perceptions of tail risks not only helps to mitigate their materialisation, but it also facilitates better transmission of monetary policy measures.[1]

Since the outset of the financial crisis in 2008, the main advanced economies' central banks have implemented a wide range of unconventional measures to complement more traditional policies for handling key policy rates. These measures include asset purchases and the introduction of forward guidance. The use of these instruments has meant that monetary policy transmission mechanisms now include new channels such as liquidity, signalling and portfolio rebalancing channels[2], as well as other assets and financial markets through, for example, their impact on economic agents' perceptions of the risk of different events and of the financial sector's readiness to assume risks.[3]

This article provides empirical evidence showing that the unconventional measures of the European Central Bank (ECB) and of the US Federal Reserve (the Fed) adopted in recent years have indeed reduced tail risks.[4] Following a brief explanation of the

1 Asset purchases by the central bank could insure against tail events. See Brunnermeier and Sannikov (2013).
2 See Berganza et al. (2014).
3 See Borio and Zhu (2012).
4 This article is based on the paper by Alonso, Serrano and Vaello (2020).

methodology applied to approximate markets' ex ante perceptions about extreme events, there is a description of the development of these perceptions during the global financial crisis and the current health crisis. Next, the impact of the announcements of monetary policy measures on these perceptions is analysed using an "event study" and a Bayesian structural vector autoregressive (VAR) model.

Tail risks during the financial crisis and the COVID-19 crisis

When investors take positions in the stock index options market at different time horizons (maturities), they reveal their expectations about the probabilities they assign to the future states of the underlying asset and their degree of risk aversion. These states also reflect the view about the future economic situation (and, more specifically, about future developments in the valuations of listed companies) which underlies the reference stock market indices. Based on the information on observed option prices, the so-called "risk-neutral densities"[5] can be extracted daily. They summarise the subjective probability of all the states of the underlying variable, including those states associated with extreme macro-financial events.[6] The options traded daily on the EURO STOXX 50 and the S&P 500 stock market indices (which are representative of the main listed companies in the euro area and the United States) are used, respectively, to estimate the "risk-neutral densities" for the euro area and the United States. The probabilities of adverse extreme events can be extracted from each full distribution of expected events, for each maturity, by calculating the probability of the corresponding stock market index falling by between at least 5% and 10% at different horizons.

As an example, Chart 1 displays the probabilities estimated for several dates that within one and three months of those dates, the reference stock market indexes (EURO STOXX 50 and S&P 500) would fall by at least 10% during the time period associated with the global financial crisis and the subsequent recovery.[7] The chart shows that these probabilities recorded the peaks in the sample analysed after the collapse of Lehman Brothers, when they climbed from 5%, approximately, mid-2008 to slightly more than 30% at-end 2008 for the one-month horizon both in the euro area and in the United States. The main announcements of unconventional monetary stimulus programmes by the ECB and the Fed – identified by their initials in Chart 1 – were associated with lower strains in their respective stock markets.

Turning to the more recent period, the rapid spread of the pandemic and the containment measures required have led, since February 2020, to an increase in tail

5 See Breeden and Litzenberger (1978).

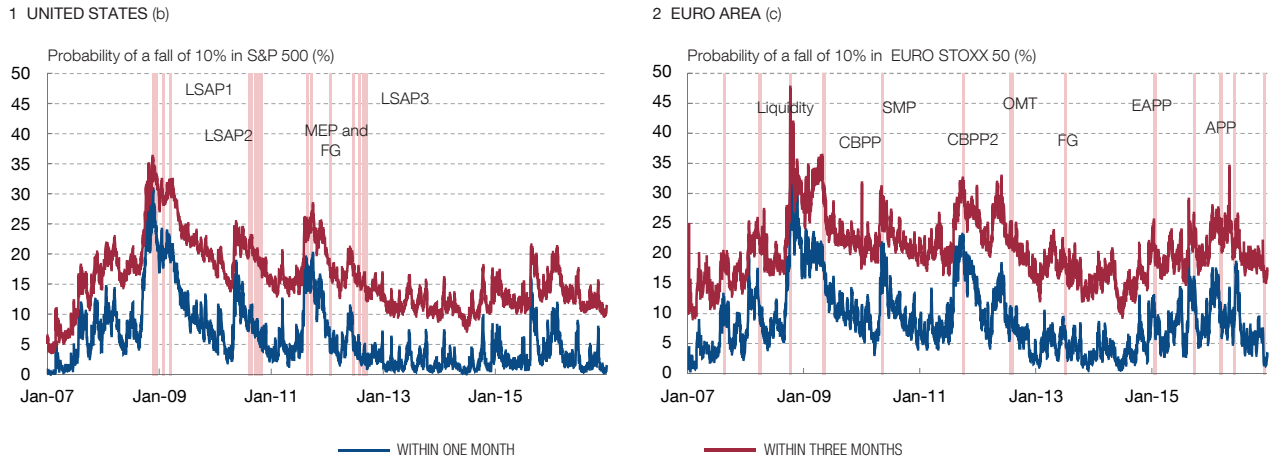
6 Note that these subjective probabilities differ from the real probabilities which agents assign to each occurrence since they also include an adjustment for investors' risk preferences.

7 For the calculation of these indicators, see Alonso et al. (2020). The time period is that analysed in this reference.

Chart 1

DEVELOPMENTS IN THE PERCEPTIONS OF TAIL RISKS AND UNCONVENTIONAL MONETARY POLICY MEASURES DURING THE GLOBAL FINANCIAL CRISIS (a)

Perceptions of tail risks rose significantly at times of great uncertainty, such as after the collapse of Lehman Brothers in September 2008. The Fed's and the ECB's most significant announcements of unconventional measures seem to have eased tensions in financial markets.



SOURCES: OptionMetrics and Banco de España.

a Time series of the probability estimated of a decline of 10% in the corresponding stock market index (S&P 500 and EURO STOXX 50) in one month (blue line) and three months (red line). The vertical lines represent the respective central banks' announcements of unconventional monetary policy measures. The data frequency is daily and runs from January 2007 until December 2016.
b LSAP (large-scale asset purchases), MEP (maturity extension programme) and FG (forward guidance).
c CBPP (covered bond purchase programme), SMP (securities market programme), OMT (outright monetary transactions), FG (forward guidance), EAPP (expanded asset purchase programme), APP (asset purchase programme).

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risks which are of a similar intensity to that observed during the global financial crisis (see Chart 2). In fact, as shown in the chart, the probabilities estimated at different dates that the reference stock market indices (S&P 500 and EURO STOXX 50) would fall by at least 10% in the following month increased from levels of close to 2% mid-February in the euro area and in the United States, to values of approximately 30% and 35%, respectively, mid-March. Both the ECB and the Fed reacted decisively and swiftly, by announcing significant unconventional measures.[8] Following these announcements, the probabilities estimated of falls of at least 10% in the reference stock market indices (S&P 500 and EURO STOXX 50) within one month began to dissipate and gradually began to decrease to values of around 15% at end-April.

The effect of the monetary policy announcements can also be analysed by looking at the behaviour of the complete risk-neutral densities on specific dates, such as the announcement by the ECB of the pandemic emergency purchase programme (PEPP) on 18 March,[9] or the abandonment of asset purchase quotas by the Fed on

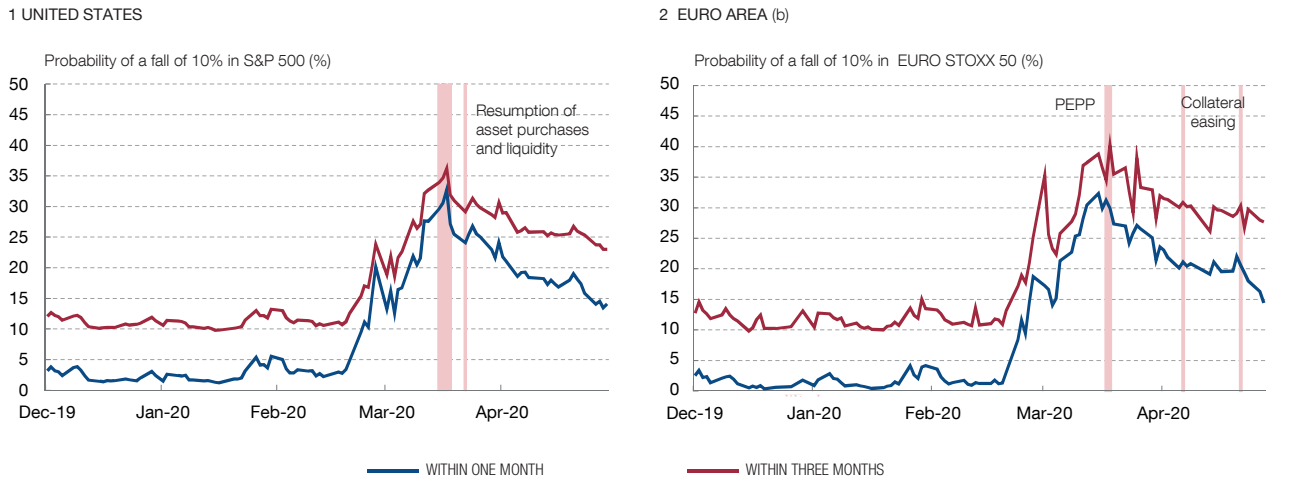
8 See Chapter 3.4 of the Banco de España Annual Report (2019).

9 The announcement was made on 18 March after the stock markets closed and, consequently, the behaviour of a day after is analysed.

Chart 2

DEVELOPMENTS IN THE PERCEPTIONS OF TAIL RISKS AND UNCONVENTIONAL MONETARY POLICY MEASURES DURING THE COVID-19 CRISIS (a)

In the aftermath of the outbreak of the health crisis, perceptions of tail risk rose sharply in the United States and in the euro area, with a similar intensity to that experienced during the global financial crisis, to reach rates of close to 35%, and only seemed to dissipate partially following the announcement of significant unconventional monetary policy measures.



SOURCES: OptionMetrics and Banco de España.

a Time series of the probabilities of a decline of 10% in the corresponding stock market index over the time horizon of one month (blue line) and three months (red line). The vertical lines represent the respective central banks' announcements of unconventional monetary policy measures. The data frequency is daily and includes from December 2019 until April 2020.
b PEPP (pandemic emergency purchase programme).

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23 March.[10] Both decisions were accompanied by a reduction in the probability mass at the left-hand tail of the distribution (where the more negative events are concentrated) for a horizon of one month, as shown in Chart 3. This chart shows the risk-neutral densities on the day of the announcement (in red), a day before (in blue) and a day after (in yellow).[11] In economic terms, these changes in the densities before and after the monetary policy announcement reflect lower demand for hedging by investors against extreme movements in asset portfolio valuations.[12]

In order to bolster the analysis presented in the preceding paragraphs, in the following section the same variables (tail risk measures and monetary policy decisions) are linked to one another by using several quantitative tools.

10 In the latter case, investors' expectations about an agreement being reached on a wide-ranging fiscal package in the United States, which was finally approved on 27 March, may also have influenced the improvement in perceptions of tail risks during the preceding days since the S&P 500 was affected positively. Alternatively, the announcement of substantial liquidity-boosting measures on 17 March is also associated with reductions in the left-hand tail of the distribution.

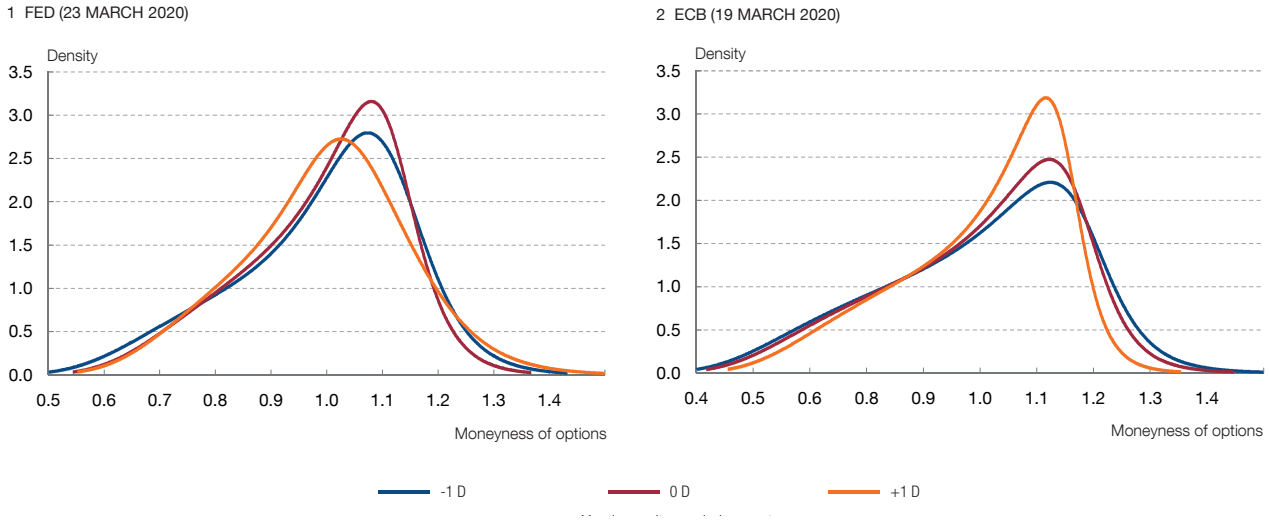
11 The metric used in the chart is the "moneyness" of options. Where moneyness is equal to one, markets envisage that the price of the stock market index within a month will be equal to the current present price. By contrast, if moneyness is equal to 0.9, markets envisage a 10% decline in the stock market index.

12 Ampudia, Baumann and Fornari (2020) perform a similar analysis and conclude that the upside potential of share prices increased following the announcement of substantial monetary stimulus in the euro area. These authors estimate "risk-neutral densities" on the basis of options with a one year maturity and derive a risk aversion indicator.

Chart 3

CHANGES IN RISK-NEUTRAL DENSITIES ON DAYS OF MONETARY ANNOUNCEMENTS DURING THE COVID-19 CRISIS (a)

Faced with the sharp economic and financial downturn triggered by the health crisis, the Fed and the ECB announced significant unconventional measures. An analysis of investors' reactions on the day of certain announcements (such as the abandonment of asset purchase quotas by the Fed on 23 March and the ECB's new pandemic emergency purchase programme on 19 March) suggest that these measures were relevant in reducing perceptions of extreme events in the left-hand tail of the distribution.



SOURCE: author's calculations.

a The panels show changes in the "risk-neutral densities" for a one-month horizon on the dates indicated for the announcements of unconventional monetary policy measures by the moneyness of options. Where moneyness is equal to one, the price of the underlying asset in 30 days is equal to the current present price. For a value of 0.9, markets estimate a fall of 10% in the underlying asset one month ahead. The figures show the "risk-neutral densities" implied in the corresponding stock market indices (S&P 500 for the United States and EURO STOXX 50 for the euro area) as at the date of the announcement (red line) and on the preceding days (blue) and on the subsequent days (yellow).

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The effect of unconventional measures on perceptions of tail risk

First, the impact of the announcements of unconventional monetary policies (captured through a dummy) on changes in perceptions of tail risks[13] is estimated on the basis of an "event study" for each area. According to this analysis which was undertaken with daily data from January 2007 to end-2016, between 9% (the ECB) and 14% (the Fed) of the fall observed in the probabilities anticipating a decline of 10% or more in the stock market index over the horizon of one month can be attributed to unconventional monetary policy (see Table 1, columns 2 and 4). The probability of a decline of 5% or more, by contrast, decreases to a lesser extent, to between 3% (the ECB) and 5% (the Fed). Consequently, monetary policy announcements seem to have affected more extreme risks to a greater degree. Lastly, the impact on tail risks is higher for shorter-term horizons (one month as opposed to three months). This means that unconventional monetary policy

13 This approach assumes that, in a very small window of time around these announcements (one day), financial assets will only respond to these monetary policy announcements. Additionally, they are controlled for other pertinent announcements such as the publication of macroeconomic data and other central banks' announcements of monetary measures.

Table 1

THE IMPACT OF UNCONVENTIONAL MONETARY POLICY ON TAIL RISKS AT DIFFERENT HORIZONS (a)

The announcements of unconventional monetary policy measures have reduced perceptions of tail risks at different horizons and for different thresholds, and the closer the perceived risk, the greater their impact. For example, these announcements are associated with a decrease in perceptions of the probability of a decline of 10% in the corresponding stock market index (S&P 500 and EURO STOXX 50) of 14% for the Fed and 9% for the ECB.

Area	Fed		ECB	
Variables	Tail risk, 5	Tail risk, 10	Tail risk, 5	Tail risk, 10
One month	-0.05***	-0.14***	-0.03***	-0.09***
	[0.012]	[0.032]	[0.011]	[0.028]
Two months	-0.03***	-0.06***	-0.01*	-0.03**
	[0.007]	[0.012]	[0.008]	[0.014]
Three months	-0.02***	-0.04***	-0.01	-0.02
	[0.005]	[0.009]	[0.009]	[0.012]
Observations	2,517	2,517	2,541	2,541

SOURCE: Alonso et al. (2020).

a The sample period runs from January 2007 until December 2016. The dependent variable refers to the daily change in the implied probability in the options of a decline of 5% and 10% in the S&P 500 and in the EURO STOXX 50 for a period t = one, two or three months. The explanatory variable is a dummy which controls for the dates of the announcement of the main unconventional monetary policies in each area, including liquidity measures. All the regressions have been controlled for other significant macroeconomic announcements and announcements of unconventional measures in other areas, although they are not referenced in this table. The Newey-West standard errors are shown in brackets, and *** p<0.01, ** p<0.05, * p<0.1.

constitutes a significant signalling mechanism for mitigating current tail risks, but its effects are diluted with the horizon considered.[14]

Second, a Bayesian structural VAR model estimated with monthly data from January 2007 to December 2016, both for the euro area and the United States, is used in order to analyse the dynamic effects of the unconventional measures on risk perception. This model is based on four macroeconomic and financial variables: real monthly GDP,[15] the CPI, the shadow rate of Wu and Xia (2016),[16] which approximates the monetary policy stance, and perceptions of extreme events identified by the probability of a decline in the corresponding stock market index (S&P 500 for the United States and EURO STOXX 50 for the euro area) of at least 10% over the horizon of one month. Structural shocks are identified by following a sign restrictions framework, which differentiates between supply, demand, unconventional monetary policy and financial uncertainty shocks. Specifically, an unconventional monetary shock is determined by a contemporaneous reduction in shadow rates and a positive reaction of inflation and GDP with a one-month lag in both cases.[17]

14 Monetary policy is influenced by the state of the economy at present and may vary in the medium term depending on the economic and financial situation, and on external shocks which may affect this situation.

15 In order to obtain monthly data, real quarterly GDP is interpolated based on Chow-Lin's decomposition and by using industrial production as the reference series.

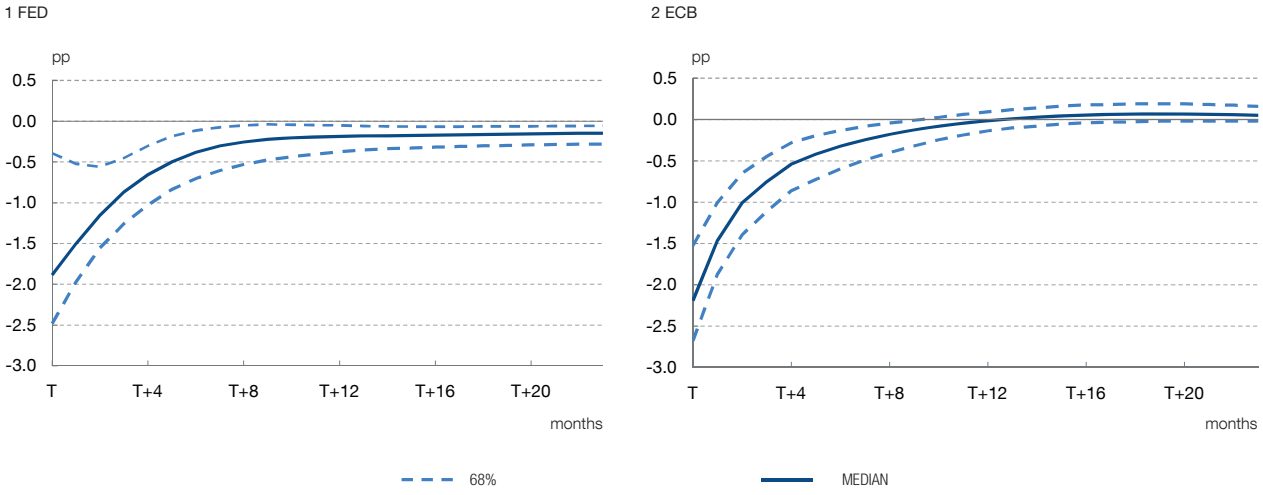
16 The shadow rate includes announcements of monetary measures and the implementation of unconventional monetary policy measures such as asset purchase programmes and forward guidance.

17 Alternatively, other identifications are considered for the Bayesian structural VAR model such as sign identification with balance sheet expansion or through the Cholesky descomposition, among others.

Chart 4

THE EFFECT OF AN UNCONVENTIONAL MONETARY SHOCK ON TAIL RISK PERCEPTIONS (a)

The findings based on a Bayesian structural (VAR) model confirm that the announcements of unconventional measures temporarily reduce tail risk perceptions. Thus, a one standard deviation unconventional monetary shock decreases perceptions of extreme events in the United States and in the euro area by approximately 2 pp at the time of the announcement and its effect dissipates until it disappears a year after the announcement.



SOURCE: Alonso et al. (2020).

a The charts show the impulse-response function of tail risk perceptions to a one standard deviation (expansionary) unconventional monetary shock according to a Bayesian structural (VAR) model using monthly data from January 2007 until December 2016. The structural shocks are identified by following a sign restrictions framework, which differentiates between supply, demand, unconventional monetary and financial uncertainty shocks. Each panel shows the median of the subsequent distribution (unbroken line) and the series which delimit the credibility interval at 68% (broken lines).

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This alternative approach confirms that unconventional monetary policy was positive for facilitating monetary policy transmission since it temporarily eased the financial tensions in equities markets and improved agents' expectations. According to the findings of this model, a one standard deviation unconventional monetary shock, involving a fall of approximately 10 basis points (bp) in the shadow rate, reduces perceptions of extreme events by approximately 2 percentage points (pp) at the time of impact in both economies (see Chart 4). However, this effect is temporary and disappears within a year.

In short, the announcements of unconventional monetary measures by the Fed and the ECB have prompted the temporary reduction in financial markets' perceptions of tail risks during the global financial crisis and the current COVID-19 crisis, and have facilitated monetary policy transmission.

16.12.2020.

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