THE EFFECT OF THE EUROPEAN CENTRAL BANK'S ASSET PURCHASE PROGRAMMES ON SPAIN'S PUBLIC FINANCES

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Abstract

This paper empirically quantifies the effect on Spain's public finances of the asset purchase programmes implemented in the euro area between 2015 and 2022. Specifically, it evaluates the impact of the ECB's Asset Purchase Programme (APP) and Pandemic Emergency Purchase Programme (PEPP) on Spanish public revenue, expenditure, deficit and debt. The results suggest that these programmes have had a significant cumulative downward effect on the level of public debt.

Keywords: quantitative easing, asset purchase programmes, unconventional monetary policy, term structure models, signaling and portfolio balance effects, expectations channel, fiscal effects, Spain.

JEL classification: E43, E44, E52, E63, E65, G18.

Resumen

Este documento ofrece una cuantificación empírica del efecto sobre las cuentas públicas en España de los programas de compras de activos implementados en el área del euro entre 2015 y 2022. En particular, se evalúa el impacto sobre los ingresos, los gastos, el déficit y la deuda pública de España del *Asset Purchase Programme* (APP) y el *Pandemic Emergency Purchase Programme* (PEPP). Los resultados sugieren que ambos programas habrían tenido un significativo efecto acumulado a la baja sobre la ratio de deuda pública.

Palabras clave: expansión cuantitativa, programas de compras de activos, política monetaria no convencional, modelo estructural de curva de tipos, efectos señalización y reequilibrio del balance, canal de expectativas, efectos fiscales, España.

Códigos JEL: E43, E44, E52, E63, E65, G18.

Content

1 Introduction

Following the 2008 financial crisis, central banks in the main advanced economies adopted unconventional monetary policy measures, in response to a situation where medium-term inflation prospects were below their target levels and short-term interest rates – the conventional monetary policy instrument – were approaching their lower bound. Of note among such unconventional measures was the implementation of large-scale asset purchase programmes, which aimed to reduce medium- and long-term interest rates and thereby stimulate economic activity and support the return of inflation to its target level.

The economic literature has studied in depth the effects of asset purchase programmes on both financial conditions[1] (including long-term interest rates) and economic activity and inflation.[2] However, it has paid relatively little attention to the implications of such programmes for the public finances.

This paper quantifies the effect of the asset purchase programmes implemented in the euro area between 2015 and 2022 on Spain's public finances. In particular, it quantifies the impact on public revenue and expenditure of the balance sheet expansions carried out by the Eurosystem (i.e. the European Central Bank (ECB) and the euro area national central banks (NCBs), including the Banco de España) under the Asset Purchase Programme (APP) and the Pandemic Emergency Purchase Programme (PEPP).

These programmes affect the public finances through various channels. First, unconventional monetary policy operations affect the Eurosystem's profit and loss account and, consequently, the dividends transferred by the NCBs to the respective national treasuries. In the case of Spain, operations related to asset purchase programmes between 2015 and 2022 led to an increase in gross interest income of €25.7 billion (see Chart 1).[3] This allowed the Banco de España to transfer dividends to the Spanish Treasury amounting to almost 0.2% of Spain's annual GDP on average over this period (see Chart 2). Yet despite these dividend distributions, this interest income also allowed the Banco de España to expand its provisions against future balance sheet risks. By the end of 2022, these provisions had risen to €33.64 billion.

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1 See, for example, Gagnon, Raskin, Remache and Sack (2011) – which summarises the financial effects of the first major asset purchase programme (LSAP1) conducted by the Federal Reserve – and Krishnamurthy and Vissing-Jorgensen (2011) or Christensen and Rudebusch (2012). For the case of the United Kingdom, see Joyce, Lasaosa, Stevens and Tong (2011) and Breedon, Chadha and Waters (2012). For the euro area, see Eser and Schwaab (2016), Eser, Lemke, Nyholm, Radde and Vladu (2023), De Santis and Holm-Hadulla (2020) and Altavilla, Carboni and Motto (2021).

2 See, for example, Gambetti and Musso (2017) for the euro area, Weale and Wieladek (2016) for the United States, and Kapetanios, Mumtaz, Stevens and Theodoridis (2012) for the United Kingdom. For the case of Spain, see Aguilar, Arce, Hurtado, Martínez-Martín, Nuño and Thomas (2020) and Aguilar, Arencibia, Costain, Hurtado, Martínez-Martín, Nuño and Thomas (2022).

3 Gross income from monetary policy operations does not take into account interest expenses associated with these operations (mainly the remuneration of reserves issued to finance asset purchases). However, even considering the recent increase in the average cost of liabilities incurred through monetary policy operations (including both the remuneration of the reserves held by financial institutions at the Banco de España and the deposit facility and the remuneration of the intra-Eurosystem accounts), which rose from -0.2% to 0.3% between 2021 and 2022, net income from the two purchase programmes remains high (at around €5.9 billion and €4.6 billion, respectively, not including the redistribution of the Eurosystem's monetary income). These figures are reduced by the recent provisioning for financial risks, which, in net terms, amounted to €3.2 billion and €1.6 billion in 2021 and 2022, respectively, meaning that net income continued to stand at around €3 billion on the dates considered.

1.a Securities held for monetary policy purposes

€m

Legend:
- Total PEPP
- Total CSPP
- Total PSPP
- Total SMP
- Total CBPP

1.b Interest income

€m

Legend:
- Total PEPP
- Total CSPP
- Total PSPP
- Total SMP
- Total CBPP
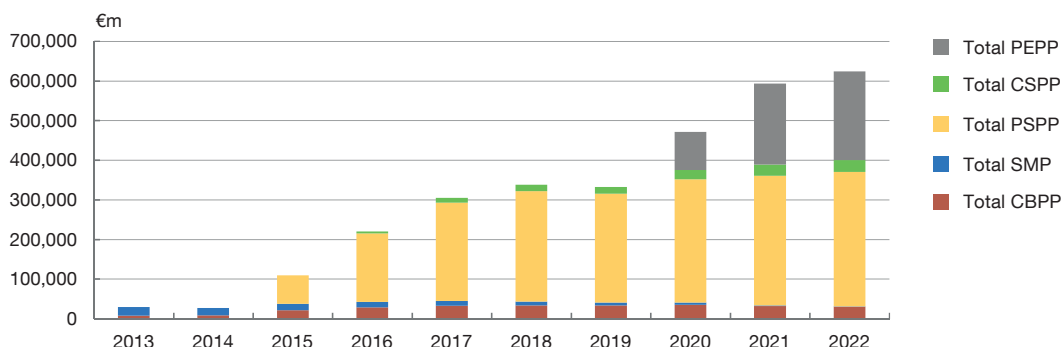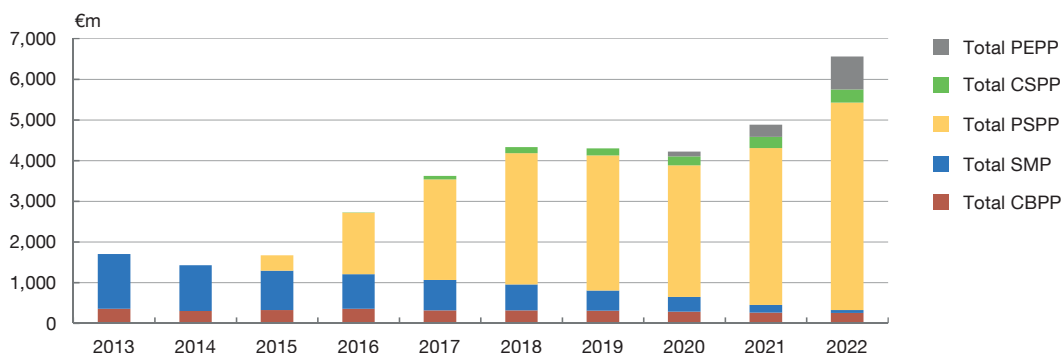
SOURCE: *Annual Accounts* of the Banco de España. Latest observation: 2022.

Looking ahead, as a result of the ECB's recent monetary policy tightening cycle, dividends from NCBs are expected to decline significantly. On one hand, this reflects a deterioration in their profit and loss accounts due to higher remuneration paid to banks holding short-term deposits with NCBs. On the other hand, it also reflects lower income from portfolio assets (especially public debt), which are generating less interest income since they were acquired in a period of low interest rates and often have long maturities.[4]

Second, the fall in interest rates on public debt prompted by central bank asset purchases reduces the interest burden of that debt, and thus the total public deficit. For example, Burriel, Martí and Pérez (2017) find that the euro area's unconventional monetary policy in 2014-2016 appears to have generated cumulative savings for the Spanish public finances of almost 1 percentage point (pp) of GDP, in the form of lower interest on public debt.

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4   See Gros and Shamsfakhr (2022) for a quantification of potential losses in the PSPP (the APP's government bond purchase sub-programme) and PEPP portfolios for the period 2023-2024 in different euro area countries. For a technical explanation, see Esteban and Romo (2024).

Chart 2
Dividends transferred by NCBs to their national treasuries

% of GDP

Legend: Spain, Germany, France, Italy
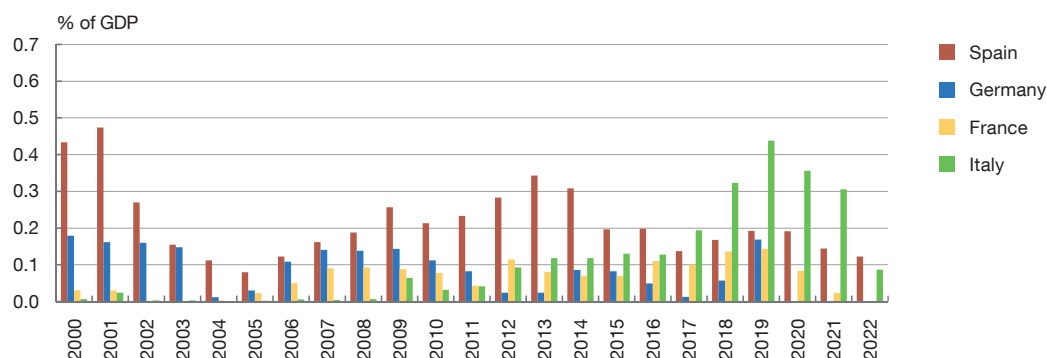
SOURCES: Bundesbank, Banque de France, Banca d'Italia, Banco de España and Eurostat.

However, the potential impact of asset purchase programmes on the public finances goes beyond the effect on dividends paid to the Treasury and the reduction of public debt costs. The reduction in interest rates leads to additional equilibrium e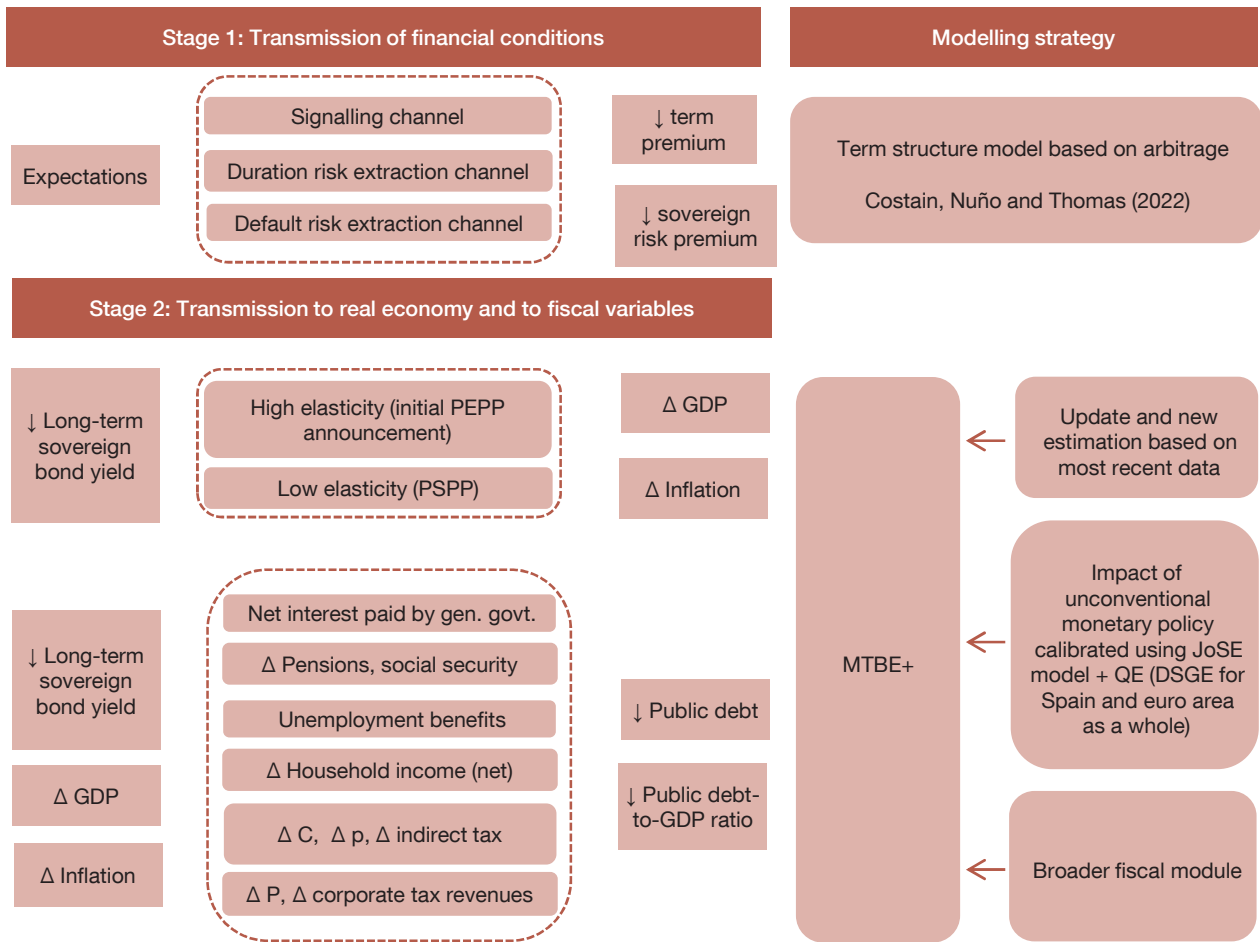ffects on the public finances through its macroeconomic impact. This paper seeks to evaluate these latter macroeconomic transmission channels, together with the interest burden reduction channel.

The reported results should be taken with caution. First, this is a retrospective exercise that quantifies the impact up to 2022 of the ECB's asset purchase programmes on Spain's public finances, and it must not be assumed that the results can be applied symmetrically in the current setting of Eurosystem balance sheet reduction. Second, it must be kept in mind that an analysis of asset purchase programmes provides only a partial picture of the overall effects of monetary policy. The ongoing reduction in Eurosystem asset holdings coincides with the broader normalisation of the ECB's monetary policy that began in December 2021, affecting not only its main instrument (policy interest rates) but also its targeted refinancing operations (TLTROs).

Lastly, measuring the macroeconomic impact of asset purchases poses analytical difficulties, as it requires a conceptual framework to analyse their propagation through the real economy via multiple channels. In particular, quantifying the impact of asset purchases on the public finances requires a quantitative modelling framework. This paper uses two analytical tools that seek to assess, first, the impact of asset purchases on long-term interest rates and, second, the impact that these rates have on the main macroeconomic variables, and thereby on the public sector's various income and expenditure items. Figure 1 outlines the analytical strategy employed in this paper. In a first stage, discussed in the following section, the impact of asset purchases on financial conditions is quantified, focusing in particular on long-term interest rates on public debt. A second stage, discussed in section 3, analyses the effect of financial conditions on macroeconomic variables and, through these, on public revenue and expenditure, deficit and debt.

Figure 1

Transmission channels of asset purchases for monetary policy purposes

Stage 1: Transmission of financial conditions		Modelling strategy
Expectations	Signalling channel	
	Duration risk extraction channel	
	Default risk extraction channel	

↓ term premium

↓ sovereign risk premium

Term structure model based on arbitrage

Costain, Nuño and Thomas (2022)

Stage 2: Transmission to real economy and to fiscal variables

↓ Long-term sovereign bond yield

High elasticity (initial PEPP announcement)

Low elasticity (PSPP)

Δ GDP

Δ Inflation

MTBE+

Update and new estimation based on most recent data

↓ Long-term sovereign bond yield

Net interest paid by gen. govt.

Δ Pensions, social security

Unemployment benefits

Δ Household income (net)

Δ C, Δ p, Δ indirect tax

Δ P, Δ corporate tax revenues

Δ GDP

Δ Inflation

↓ Public debt

↓ Public debt-to-GDP ratio

Impact of unconventional monetary policy calibrated using JoSE model + QE (DSGE for Spain and euro area as a whole)

Broader fiscal module

SOURCE: Banco de España.

2 The effects of asset purchases on long-term interest rates

The purpose of Eurosystem asset purchases – purchases of public debt issued by governments and other euro area public sector institutions, as well as bonds from the safest corporate issuers – is to stimulate the economy by reducing the longer-term interest rates faced by households, firms and other economic agents. These long-term rates are the sum of three components: expectations of future short-term rates, the term premium and the default premium.[5] Asset purchases affect each of these components in different ways.

First, through the signalling channel, bond purchases signal to markets the central bank's commitment to engage in expansionary monetary policy. This changes market expectations about the future course of short-term interest rates, which in turn passes through to long-term rates.

Second, through the duration risk extraction channel, the central bank absorbs a portion of the duration risk on the market. Duration risk stems from the variability of the market prices of medium and long-term bonds over their term to maturity. When the central bank buys bonds from investors, it expands their capacity to absorb new risks. This reduces the market price of risk and thus also the term premium component of bond yields (i.e. the remuneration required by investors to assume duration risk).

Third, there is the risk that a bond issuer will default on its future payment obligations. To compensate for this risk, investors demand a default premium. As in the case of the term premium, central bank purchases shift this risk from private investors to the central bank, which reduces the default premium component of yields – a channel called "default risk extraction".

The expansion of the APP and the creation and implementation of the PEPP[6] increased the extraction of these risks, in the context of a sharp increase in the volume of debt issuance, offsetting the severe rise in long-term interest rates that would otherwise have occurred and thereby stimulating the economy.

This paper uses a structural model of the yield curve, designed to encompass both stock and flow effects of purchases, to estimate how the announcements of net purchases under the APP and PEPP programmes affected long-term rates in the Spanish economy. The model, described in Costain, Nuño and Thomas (2022), is based on the one developed by Vayanos and Vila (2021) to analyse the impact of quantitative easing (QE) in the United States. Unlike the latter, the framework of Costain, Nuño and Thomas (2022) is a multi-country model, calibrated to explain the behaviour of sovereign yield curves in the euro area both before and during the pandemic. It also incorporates the

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5 See Vayanos and Vila (2021) and Eser, Lemke, Nyholm, Radde and Vladu (2023).

6 The PEPP, together with the new purchases under the APP, increased the portfolio of the Eurosystem's securities purchase programmes to around €5 trillion.

Date	Programme	Announcement
22 January 2015	APP	[...] launch an expanded asset purchase programme, encompassing the existing purchase programmes for asset-backed securities and covered bonds. Under this expanded programme, the combined monthly purchases of public and private sector securities will amount to €60 billion. They are intended to be carried out until end-September 2016 and will in any case be conducted until we see a sustained adjustment in the path of inflation which is consistent with our aim of achieving inflation rates below, but close to, 2% over the medium term [...]
3 December 2015	APP	[...] we decided to extend the asset purchase programme (APP). The monthly purchases of €60 billion under the APP are now intended to run until the end of March 2017, or beyond, if necessary [...]
10 March 2016	APP	[...] we decided to expand the monthly purchases under our asset purchase programme from €60 billion at present to €80 billion. They are intended to run until the end of March 2017, or beyond, if necessary [...]
8 December 2016	APP	[...] we will continue to make purchases under the asset purchase programme (APP) at the current monthly pace of €80 billion until the end of March 2017. From April 2017, our net asset purchases are intended to continue at a monthly pace of €60 billion until the end of December 2017, or beyond, if necessary [...]
26 October 2017	APP	[...] we will continue to make purchases under the asset purchase programme (APP) at the current monthly pace of €60 billion until the end of December 2017. From January 2018 our net asset purchases are intended to continue at a monthly pace of €30 billion until the end of September 2018, or beyond, if necessary [...]
14 June 2018	APP	[...] we will continue to make net purchases under the APP at the current monthly pace of €30 billion until the end of September 2018. We anticipate that, after September 2018, subject to incoming data confirming our medium-term inflation outlook, we will reduce the monthly pace of the net asset purchases to €15 billion until the end of December 2018 and then end net purchases [...]
12 September 2019	APP	[...] the Governing Council decided to restart net purchases under its asset purchase programme (APP) at a monthly pace of €20 billion as from 1 November. We expect them to run for as long as necessary to reinforce the accommodative impact of our policy rates, and to end shortly before we start raising the key ECB interest rates.
12 March 2020	APP	[...] we decided to add a temporary envelope of additional net asset purchases of €120 billion until the end of the year, ensuring a strong contribution from the private sector purchase programmes [...]
18 March 2020	PEPP	The Governing Council decided the following: (1) To launch a new temporary asset purchase programme of private and public sector securities to counter the serious risks to the monetary policy transmission mechanism and the outlook for the euro area posed by the outbreak and escalating diffusion of the coronavirus, COVID-19. This new Pandemic Emergency Purchase Programme (PEPP) will have an overall envelope of €750 billion. Purchases will be conducted until the end of 2020 and will include all the asset categories eligible under the existing asset purchase programme (APP) [...]
4 June 2020	PEPP	[...] the Governing Council decided to increase the envelope for the pandemic emergency purchase programme (PEPP) by €600 billion to a total of €1,350 billion [...]
10 December 2020	PEPP	[...] the Governing Council decided to increase the envelope of the pandemic emergency purchase programme (PEPP) by €500 billion to a total of €1,850 billion. It also extended the horizon for net purchases under the PEPP to at least the end of March 2022 [...]

SOURCE: Banco de España based on the ECB.

possibility of sovereign default, taking into account default risk when calculating euro area peripheral bond yields.

This model is used to perform a simulation based on the target paths announced in eight APP and three PEPP (re)calibration policy statements (see Table 1), for the period of portfolio expansion from 2015 to the end of net purchases in 2022. The announced purchase paths are summarised in Chart 3.a, and the different paths associated with each announcement are shown in Chart 3.b.[7]

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7 The ECB statements from December 2021 onwards, announcing reductions in the pace of PEPP and, later, APP purchases have not been considered, given the difficulties in identifying their effects.

Chart 3
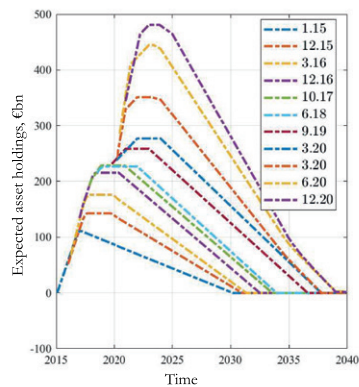**Net purchases and expected changes in the Banco de España's securities portfolios**

3.a Asset purchase programmes (APP and PEPP).
     Monthly net purchases and portfolio size

Monthly net purchases - APP
Monthly net purchases - PEPP
Monthly average - APP
Total APP + PEPP portfolio (right-hand scale)
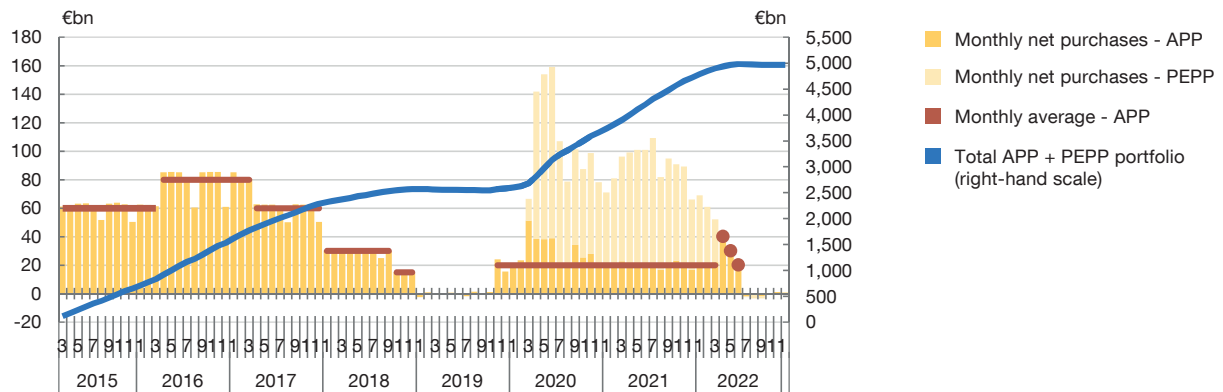
3.b Expected Spanish sovereign bond holdings after each announcement

SOURCES: ECB and Banco de España calculations.
NOTE: Chart 3.a shows the monthly net purchases made by the Eurosystem and the changes in the size of its portfolio. Chart 3.b shows the expected changes in the size of the Banco de España's sovereign bond portfolio following 11 announcements of Eurosystem QE programmes, on the indicated dates. That is, it shows the expansion of the portfolio as a result of the announced purchases, followed by the expected reinvestment and tapering phases that were anticipated at the time of the announcement. The expected paths are constructed on the basis of information on market expectations drawing on Bloomberg, Reuters and, more recently, the ECB's Survey of Monetary Analysts.

The long-term interest rate paths associated with the announced paths of securities purchases are calculated using the model. The total impact on long-term interest rates calculated from the model is illustrated in Chart 4, and the impact is broken down with respect to the successive announcements in Chart 5. For each announcement, two alternative calibrations (high and low elasticity) are considered, to illustrate the range of uncertainty associated with the model simulations.

The high-elasticity calibration is based on the fall in Spanish 10-year bond yields observed after the PEPP announcement in March 2020 (-51 basis points (bp) in the two-day

Chart 4
Change in long-term bond yields (Spain)

4.a High elasticity
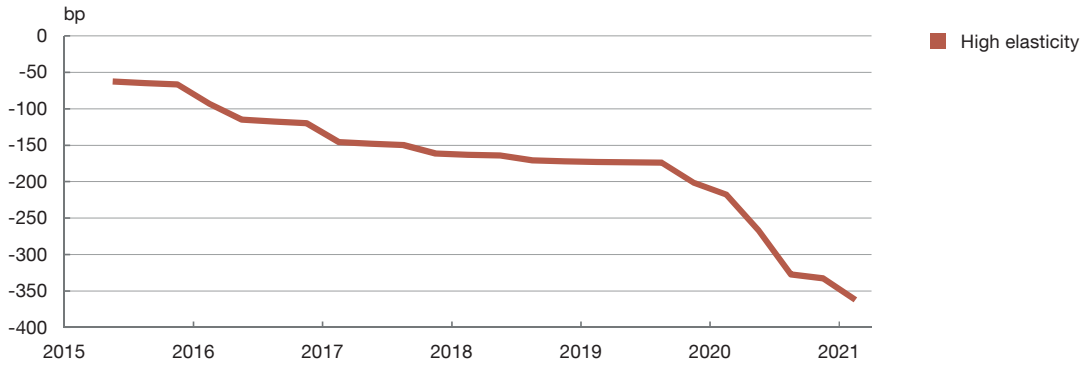
4.b Low elasticity

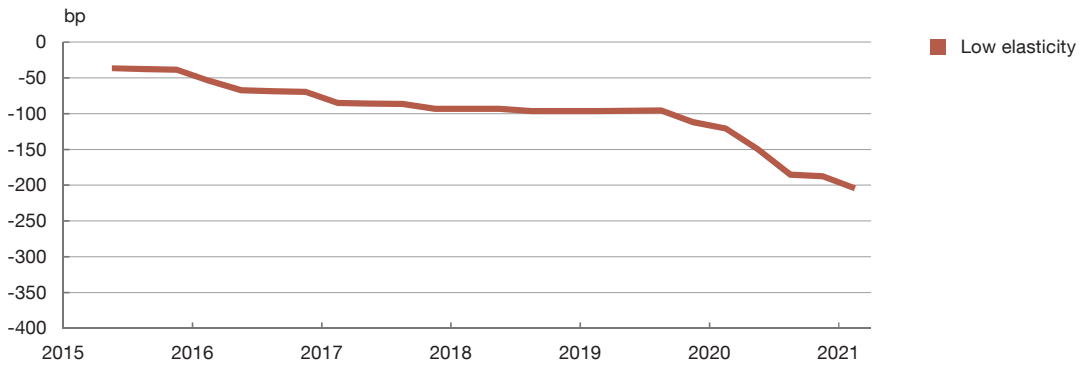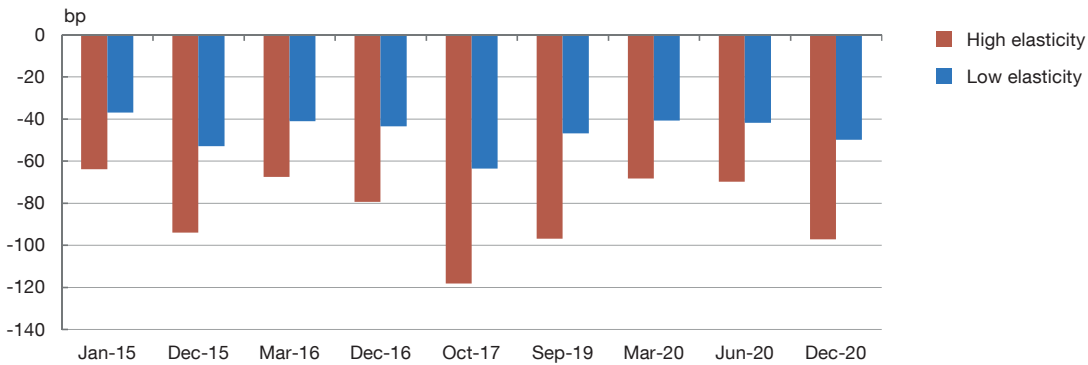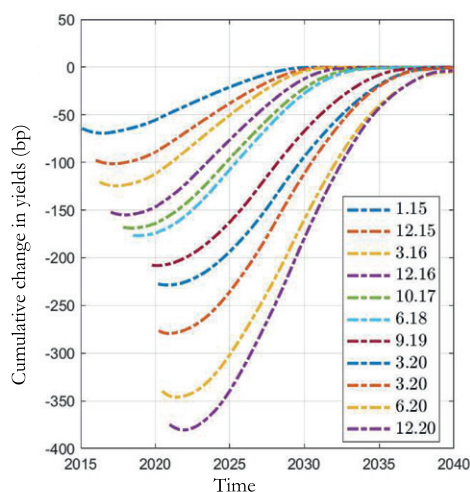SOURCE: Banco de España.
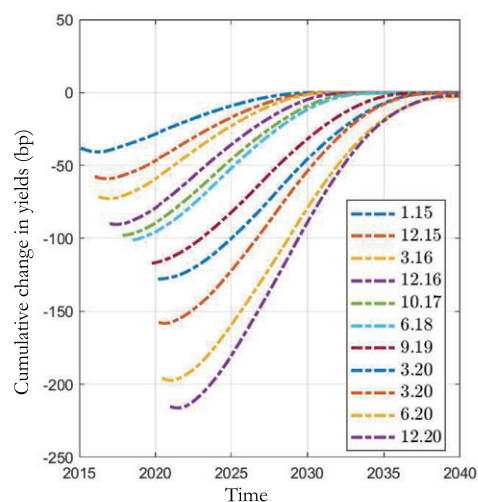
SOURCE: Banco de España.

Chart 6
Estimated impact on long-term bond yields after each announcement

6.a Expected path of Spanish 10-year sovereign bond yields after each announcement: high elasticity

6.b Expected path of Spanish 10-year sovereign bond yields after each announcement: low elasticity

SOURCE: Banco de España calculations.

window after the announcement, i.e. an effect of 68.7 bp for every €100 billion of Spanish bonds purchased). Applying the high-elasticity calibration to all the announcements of Spanish sovereign bond purchases between January 2015 and December 2020, which totalled €481 billion, results in a cumulative impact of 381 bp (see Chart 6.a). The low-elasticity calibration is based instead on the initial APP announcement on 22 January 2015, which, according to Chart 1 in Altavilla, Carboni and Motto (2021), was associated with a fall of 26 bp in Spanish 10-year bond yields on that day. However, markets were already anticipating an asset purchase programme before that day's announcement. Using the December 2014 Bloomberg survey to infer the part already anticipated, we conclude that Spanish sovereign bond purchases in the first round of the APP, amounting to €114 billion, had an impact of 40.6 bp, i.e. 35.6 bp per €100 billion. Applying the low-elasticity calibration to the series of all purchase announcements, it is estimated that the announced purchases of €481 billion had a cumulative impact of 216 bp (see Chart 6.b).[8]

In both cases, the impact observed in the data – and hence the impact inferred from the calibrated model – is substantially greater for Spain and Italy than for countries such as Germany or France.

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[8] However, it should be noted that this low elasticity probably represents an underestimation of the impact of the purchases. Analysing rate movements associated with all APP-related news between September 2014 and March 2015, and controlling for macroeconomic news, Altavilla, Carboni and Motto (2021) conclude that the impact of the first round of the APP was considerably greater, with an elasticity similar to that of the PEPP, as shown in their Table 2.

3 Macroeconomic impact of asset purchases and their effect on public finances

3.1 Models used and the role of expectations

Based on the results obtained in the previous section, the Quarterly Model of the Banco de España (MTBE, by its Spanish abbreviation) is used to estimate the effect of the asset purchase programmes on the main macroeconomic variables, and, through these, on several major public revenue and expenditure items. The MTBE is a large-scale macroeconometric model used for medium-term macroeconomic forecasting of the Spanish economy and for simulating counterfactual scenarios (simulations of economic policy measures, risk scenarios, etc.). The model is specified as a large set of error correction equations and, particularly in the short run, is mostly demand-driven.

An update of this model has recently been completed, with estimates based on more recent data (up to 2021 Q4) and incorporating changes in the specification of the models, most notably in that expectations about growth, inflation and the unemployment rate now appear explicitly in agents' main behavioural equations (for consumption, investment in housing and equipment, employment, wages, prices, etc.).[9] This indirectly overcomes a shortcoming of semi-structural models such as the MTBE, which are typically less equipped than micro-founded models to assess the impact of economic policy changes that are largely transmitted through expectations channels, as in the case of unconventional monetary policy.

The standard version of the new MTBE uses adaptive expectations: the model includes equations estimated using observed data, whereby changes in macroeconomic variables feed through to agents' expectations.[10] A second, more advanced, option (hereafter, "MTBE+CE") is to use the model within a consistent expectations framework: simulations are performed in an iterative manner, using the expectations calculated in each iteration to determine the path for expectations in the next iteration, until the process converges and a simulation is obtained whereby the expected path for GDP, inflation and the unemployment rate is identical to that actually observed in the simulation. This represents a conceptual improvement with respect to adaptive expectations, but it may not be sufficient to assess the effects of economic policies in which communication and anticipation effects play an important role, such as unconventional monetary policy. In such cases, a micro-founded model using rational expectations might be preferable.

Thus, a third version of the analysis incorporates agents' rational and forward-looking behaviour into the simulation, adding elements to the MTBE model that can approximate these channels (hereafter, the "MTBE+RE model"). To do so, a dynamic stochastic general equilibrium (DSGE) model is used to estimate the effect of quantitative easing (QE) measures

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9 For further details, see Arencibia, Hurtado, De Luis and Ortega. (2017).

10 For example, an episode of high inflation raises medium-term price expectations, and higher interest rates reduce them. The coefficients determining the net effect are estimated using data from the period 2000-2019, taking various projection exercises conducted by the Banco de España in those years as the observed value for expectations.

on inflation and real GDP, to thereby calibrate the response of MTBE expectations to the same shock. The specific model used in the simulation is JoSE (Joint Spain-Euro Area), a large DSGE model developed for Spain and the euro area, which is designed to adequately reflect the transmission of the purchase programmes to financing costs and to agents' decisions.[11] The JoSE model is calibrated to replicate the elasticity estimated with the yield curve model described in the previous section for the response of the seven-year sovereign bond yield (in line with the average residual maturity of Spanish bonds) to each of the ECB's asset purchase announcements. Using the results of these JoSE simulations (for the cases of high and low elasticity) as the basis for disciplining the response of growth and inflation expectations in the semi-structural framework, the response of the model with adaptive expectations (MTBE) is made identical to that of the rational expectations model (JoSE), resulting in a new version that we call MTBE+RE. This maintains the advantages of the semi-structural model in terms of generating more fiscal detail in the simulation.

The exercise is performed twice for each version of the model (MTBE, MTBE+CE, MTBE+RE), with one simulation replicating the results of the high-elasticity calibration and the other replicating the low-elasticity case. In total, the effects of the 11 asset purchase announcements, proxying those made by the ECB for the two purchase programmes, are simulated six times (see Table 1). In the JoSE model, the simulation takes account of the announcements sequentially: initially, only the first announcement is simulated, without agents being able to anticipate any subsequent announcements. As the quarters progress, subsequent announcements are incorporated into expectations at the times they occurred. This distinction is particularly important in rational expectations models, such as JoSE, in which agents anticipate the future effects of the measures at the time of their announcement.[12]

3.2 Fiscal channels in the MTBE

In the latest version of the MBTE model, the relationships between macroeconomic variables and major public revenue and expenditure items have been updated in line with recent evidence. Compared with previous versions of the MTBE, the elasticities in the current model for some social security contributions, direct taxes on households and firms, and unemployment benefits are somewhat higher, with respect to their corresponding bases. In addition, the definition of the tax base for direct taxes on households is refined, the rule for the revaluation of pensions is modified to index them to the year-on-year inflation rate in the last quarter of the preceding year, and the rule for net interest payments by general government is updated.

These updates reinforce the MTBE's advantage in terms of providing very detailed results for the different public revenue and expenditure items. Some of the channels incorporated in the model are:

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11 The JoSE model is particularly well equipped to estimate the effects of the QE measures on variables such as GDP or inflation, but it lacks the necessary disaggregation to analyse all the relevant fiscal variables. This is why the MTBE is used to calculate the effects on the public finances, relegating JoSE to the role of disciplining the estimation of the effects on growth and inflation.

12 The simulations with JoSE at this stage of the analysis are similar to those presented in Aguilar, Arce, Hurtado, Martínez-Martín, Nuño and Thomas (2020) and Aguilar, Arencibia, Costain, Hurtado, Martínez-Martín, Nuño and Thomas (2022).

— The reduction in long-term rates reduces the net interest paid by the public sector.

— Higher prices translate into higher pensions, and this raises pensioners' social security contributions.

— Higher employment reduces unemployment benefits.

— The rise in employment and in wages translates into higher social security contributions.

— Household income increases in net terms as a result of higher employment and higher wages, offset by higher social security contributions and lower net interest received from the public sector. This net increase in income passes through to direct taxes paid by households.

— Higher real private consumption and higher prices raise indirect tax revenues.

— Higher corporate profits in nominal terms translate into higher corporate tax revenues.

In addition, for this specific simulation exercise, three channels that are not normally incorporated into the MTBE have been added:

— Public-sector employment is exogenous (it does not respond to the other variables in the simulation, as is typically the case in the MTBE), but the non-market wage does react, to the same extent as the market wage.[13]

— Real public consumption is exogenous (it does not respond to the other variables in the simulation, as is typically the case in the MTBE), but its deflator does react, to the same extent as the private consumption deflator.

— Real public investment is exogenous (it does not respond to the other variables in the simulation, as is typically the case in the MTBE), but its deflator does react, to the same extent as the private productive investment deflator.

These rules, although imperfect, seem more appropriate for capturing trends in the pressures on the public finances than the alternative under which all these variables (both real variables and their deflators) would be exogenous and unresponsive to shocks.

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13 Public-sector wage setting is typically based on a multi-annual process. In practice, this means that inflation and public-sector wages are not highly correlated in the short term. Thus, both historically and in the sample used in this paper, the contemporaneous correlation between public and private wage growth is far higher (over 60%) than the correlations of these variables with contemporaneous or lagged growth in prices. This observation suggests that modelling public-sector wage developments based on private sector compensation developments is a plausible approximation.

3.3 Results

This revised and adapted version of the MTBE, under each of the expectations scenarios considered, is used to simulate a downward shock to long-term interest rates, consistent with that obtained from the yield curve model discussed in the previous section, for both the high and low elasticity scenarios.

Chart 7 summarises the results of these simulations for major macroeconomic variables, in terms of differences in price and wage growth rates, differences in percentage points for real variables, and differences as a percentage of GDP for fiscal variables. In keeping with previously published results, a significant effect on GDP growth and inflation is observed. In particular, under the rational expectations option (MTBE+RE), by construction, given that the JoSE model has been used to discipline the response of expectations, the results should be the same as those of Aguilar, Arce, Hurtado, Martínez-Martín, Nuño and Thomas (2020) and Aguilar, Arencibia, Costain, Hurtado, Martínez-Martín, Nuño and Thomas (2022). The consistent expectations option (MTBE+CE), which abstracts from the communication and anticipation channels included in the DSGE, gives rise to more limited effects, especially on prices, but also on real variables. The simulation based on adaptive expectations (MTBE) produces more moderate effects in all cases. However, the differences between the three formulations of expectations are smaller for fiscal variables, our main concern in this document.

Chart 8 shows the results of these simulations in terms of their revenue or expenditure effects for each of the fiscal variables considered in the MTBE, in millions of euro per year. The chart presents results for the high-elasticity calibration only, but considers all three expectations formation options (adaptive, consistent and rational). The results for the low elasticity calibration are presented in Table 2, together with the high elasticity results and with all the different expectations formation specifications. The table shows the cumulative effect on the fiscal variables over the entire 2015-2022 period.
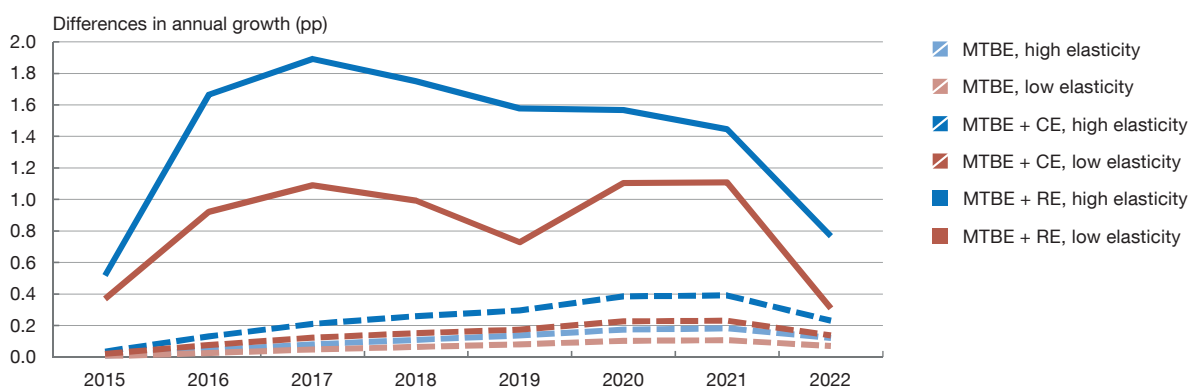
According to the estimates of the model disciplined to include rational expectations elements, which is the most appropriate for assessing policies with strong communication and anticipation channels, QE measures in recent years reduced the current Spanish public debt by an amount ranging from €77.7 billion, under the low-elasticity interest rate calibration, to €130.9 billion, under the high-elasticity calibration. This represents between 5.9% and 9.9% of GDP in 2022 (depending on the elasticity used), but the impact of the QE measures on the debt-to-GDP ratio is even greater, since they also affected the denominator. According to the rational expectations model, without the QE programmes implemented in the euro area in recent years, the public debt-to-GDP ratio in Spain at end-2022 would have been between 13.3 pp and 21.3 pp higher.

The main channels through which these effects are transmitted are: (i) the reduction in the interest paid on public debt; (ii) the increase in revenues from various government receipt items due to higher growth and nominal GDP growth; and (iii) an increase in expenditure, related to higher prices and wages, which only partially offsets the effect of (ii).

Chart 7
Estimation of the effect of the Eurosystem QE programmes on the Spanish economy

7.a GDP deflator

Differences in annual growth (pp)

- MTBE, high elasticity
- MTBE, low elasticity
- MTBE + CE, high elasticity
- MTBE + CE, low elasticity
- MTBE + RE, high elasticity
- MTBE + RE, low elasticity

7.b Private consumption deflator

Differences in annual growth (pp)

- MTBE, high elasticity
- MTBE, low elasticity
- MTBE + CE, high elasticity
- MTBE + CE, low elasticity
- MTBE + RE, high elasticity
- MTBE + RE, low elasticity

7.c Employment

Differences in percentage points

- MTBE, high elasticity
- MTBE, low elasticity
- MTBE + CE, high elasticity
- MTBE + CE, low elasticity
- MTBE + RE, high elasticity
- MTBE + RE, low elasticity

SOURCE: Simulations using the yield curve model and the MTBE.

When rational expectations derived from the JoSE model are not used to discipline the simulations, and the simulations are instead based on either the adaptive or consistent expectations version of the MTBE, the estimated cumulative effect on the public debt-to-GDP ratio at the end of 2022 falls, to between 5 pp and 11.4 pp. The reduction in the estimated effects is smaller when expressed in net or GDP terms than it

7.d Compensation per employee

Differences in annual growth (pp)

Legend:
- MTBE, high elasticity
- MTBE, low elasticity
- MTBE+CE, high elasticity
- MTBE+CE, low elasticity
- MTBE+RE, high elasticity
- MTBE+RE, low elasticity

7.e GDP

Differences in percentage points

Legend:
- MTBE, high elasticity
- MTBE, low elasticity
- MTBE+CE, high elasticity
- MTBE+CE, low elasticity
- MTBE+RE, high elasticity
- MTBE+RE, low elasticity

7.f Private consumption

Differences in percentage points

Legend:
- MTBE, high elasticity
- MTBE, low elasticity
- MTBE+CE, high elasticity
- MTBE+CE, low elasticity
- MTBE+RE, high elasticity
- MTBE+RE, low elasticity

SOURCE: Simulations using the yield curve model and the MTBE.

is when considering individual revenue and expenditure items, in euro, which are subject to greater uncertainty. That is, the assumptions that amplify the estimated effects on revenue items also increase them on expenditure and for GDP, which appears in the denominator. Therefore, the effect on the main variables of interest (the deficit or debt

7.g Budget balance

Differences as a % of GDP

- MTBE, high elasticity
- MTBE, low elasticity
- MTBE+CE, high elasticity
- MTBE+CE, low elasticity
- MTBE+RE, high elasticity
- MTBE+RE, low elasticity

7.h Public debt

Differences as a % of GDP

- MTBE, high elasticity
- MTBE, low elasticity
- MTBE+CE, high elasticity
- MTBE+CE, low elasticity
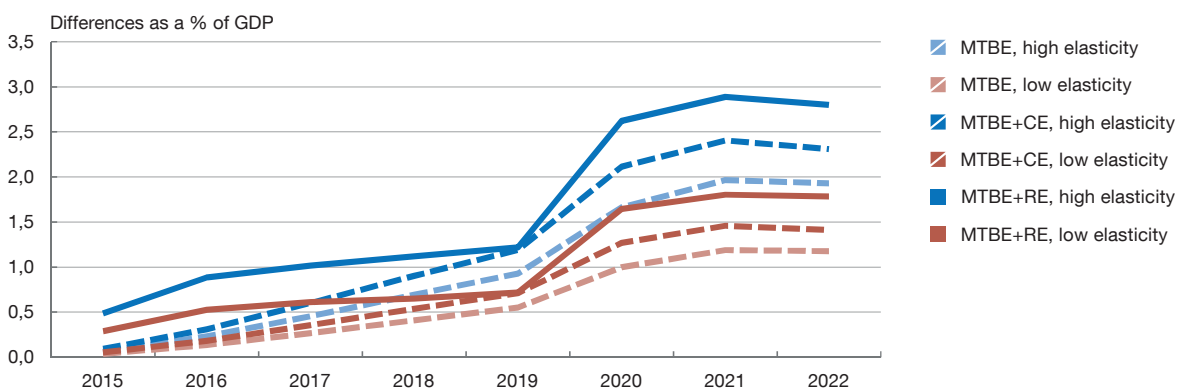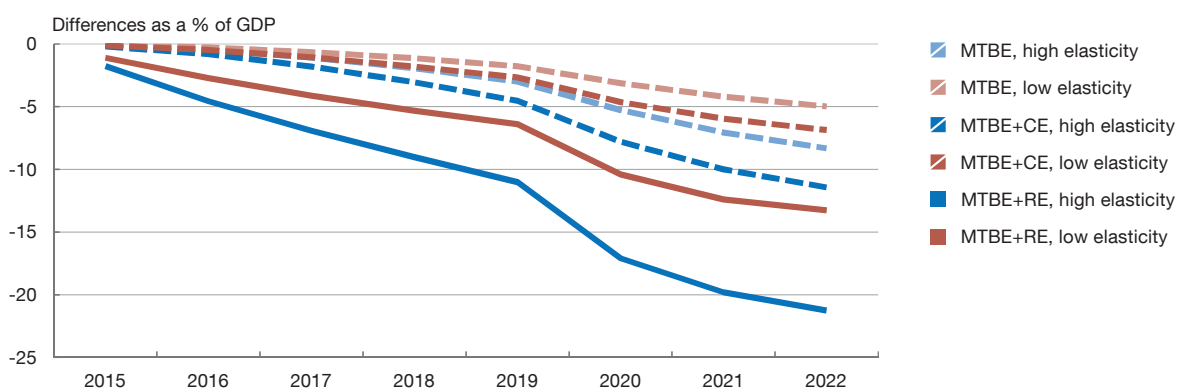- MTBE+RE, high elasticity
- MTBE+RE, low elasticity

SOURCE: Simulations using the yield curve model and the MTBE.
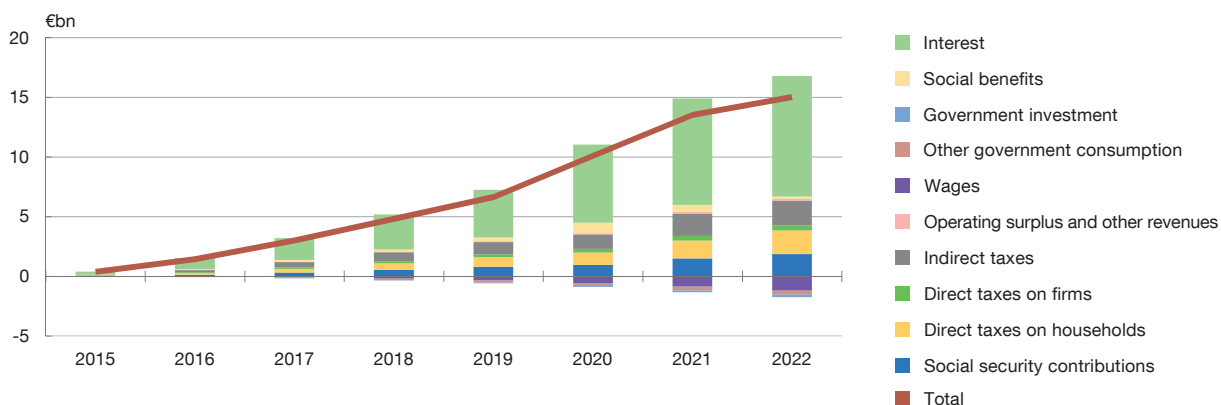
relative to GDP) is determined with greater precision than the effects on the intermediate variables individually.

In any event, these estimates may, to some extent, be considered a lower bound, as they do not incorporate two factors that may have caused QE measures to have an even greater impact on the public finances. First, the estimates described above do not incorporate the effect of having potentially averted a crisis of confidence in the Spanish economy. In the absence of QE measures, the higher public debt-to-GDP ratio could have led to a non-linear increase in the risk premium, or an abrupt fall in confidence in the Spanish economy. Such issues are not considered in this analysis. Second, these estimates do not incorporate the effect of having allowed a more flexible fiscal policy response, particularly at the onset of the pandemic, in 2020, when significant fiscal measures were implemented to mitigate its economic impact on households and firms. This flexibility might not have been possible if monetary policy had not provided sufficient fiscal space for such a response.
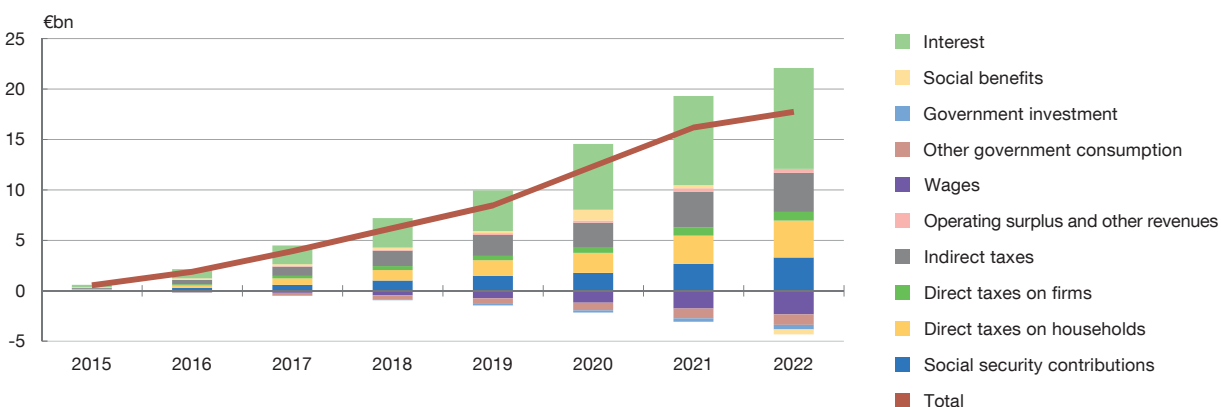
Chart 8
Effect of the QE measures on major public revenue and expenditure items in Spain

8.a Estimation with high elasticity, using adaptive expectations model (MTBE)

€bn

Legend:
- Interest
- Social benefits
- Government investment
- Other government consumption
- Wages
- Operating surplus and other revenues
- Indirect taxes
- Direct taxes on firms
- Direct taxes on households
- Social security contributions
- Total

8.b Estimation with high elasticity, using consistent expectations model (MTBE + CE)

€bn

Legend:
- Interest
- Social benefits
- Government investment
- Other government consumption
- Wages
- Operating surplus and other revenues
- Indirect taxes
- Direct taxes on firms
- Direct taxes on households
- Social security contributions
- Total

8.c Estimation with high elasticity, using rational expectations model (MTBE + RE)

€bn

Legend:
- Interest
- Social benefits
- Government investment
- Other government consumption
- Wages
- Operating surplus and other revenues
- Indirect taxes
- Direct taxes on firms
- Direct taxes on households
- Social security contributions
- Total
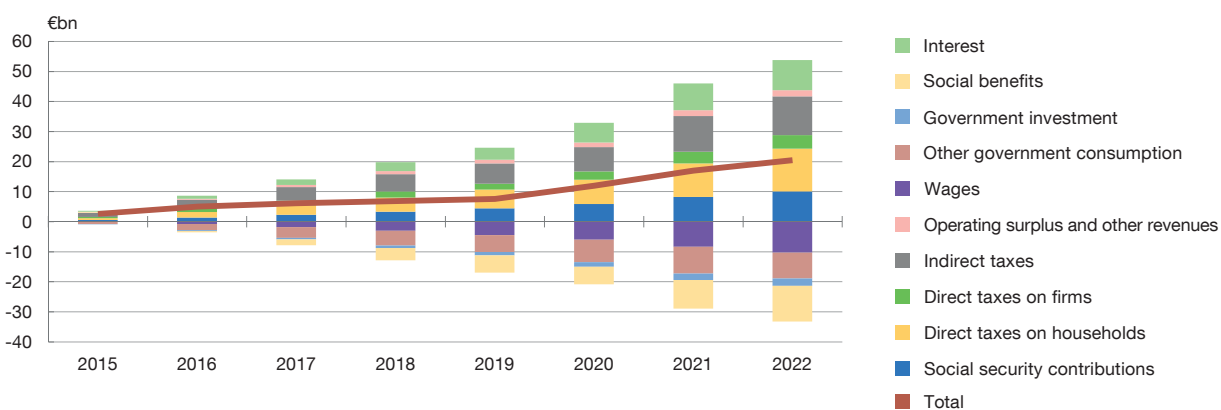
SOURCE: Estimations based on the yield curve model and the MTBE with expectations disciplined by the JoSE model.

Effect of the quantitative easing measures on public finances, considering three MTBE options
Billion euro, in cumulative terms for 2015-2022

	MTBE (adaptive expectations)		MTBE+CE (consistent expectations)		MTBE+RE (disciplined to include rational expectations elements)	
	Low elasticity	High elasticity	Low elasticity	High elasticity	Low elasticity	High elasticity
Social security contributions	6.1	10.4	11.0	18.9	35.9	61.4
Direct taxes on households	6.3	10.9	12.0	20.7	49.9	86.1
Direct taxes on firms	1.7	3.0	3.4	5.9	18.2	31.5
Indirect taxes	7.6	13.1	15.0	25.7	54.2	92.5
Gross operating surplus - public sector	0.5	0.9	1.3	2.2	8.9	15.2
Total revenue	22.3	38.3	42.7	73.4	167.2	286.6
Government consumption	4.7	8.0	11.1	18.9	76.9	131.0
Government investment	0.6	1.0	1.3	2.3	9.1	15.4
Unemployment benefits	-5.3	-9.2	-8.7	-14.8	-12.2	-20.3
Pensions	2.9	5.0	7.0	11.9	51.1	87.2
Interest	-35.5	-58.4	-35.3	-57.7	-35.5	-57.5
Total expenditure	-32.7	-53.6	-24.6	-39.4	89.4	155.8
Budget balance	54.9	91.9	67.3	112.8	77.7	130.9

SOURCE: Devised by authors.

4 Conclusions

This paper presents estimates of the impact of the quantitative easing measures adopted in the Eurosystem between 2015 and 2022 on the Spanish economy, focusing particularly on public revenue and expenditure items, and on the budget deficit and the public debt. Overall, the asset purchase programmes are estimated to have reduced Spanish public debt by between €78 billion and €131 billion, with an effect on the public debt-to-GDP ratio in Spain of between 13 pp and 21 pp at the end of 2022. If rational expectations components linked to the anticipation and communication channels are not included in this estimate, the range is reduced to between €55 billion and €113 billion, amounting to a cumulative decline in the public debt-to-GDP ratio of between 5 pp and 11 pp. These effects occur through various channels, including the impact on dividends transferred by the Banco de España, the effect on net interest paid by the public sector, and general equilibrium effects that go through economic growth and inflation, with the consequent impact on the tax bases and on the various public revenue and expenditure items.

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