II. COVID-19: the stabilising impact of EU bond issuance on sovereigns and banks

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This section explores the effects of the large-scale EU bond issuance and the ECB asset purchases in the context of a hypothetical financial crisis that would have been induced by the COVID-19 downturn. Stylised simulations show that the crisis response policies of the EU have strongly mitigated the risks associated with sovereign-bank loops in euro area countries. In particular, monetary policy action together with the introduction of a common debt instrument can more than halve potential losses to public finances from a hypothetical banking crisis. Moreover, these positive effects accrue to all Member States, even after accounting for costs linked to the extension of joint guarantees. The results also suggest that a recovery package offering a mix of both loans and grants to affected countries can be optimal for the euro area as a whole from the perspective of attenuating sovereign-bank loops.

II.1. Introduction

The COVID-19 pandemic was a severe systemic shock that affected the entire world economy. It is unprecedented in the history of the EU. According to Eurostat data, the GDP of the EU dropped by 6% in 2020, which compares with a more contained drop of about 4.2% in the financial crisis year of 2009.

A strong public intervention was deemed necessary in several countries to cope with the pandemic, and its economic and social consequences. A sizeable amount of public funds was devoted to sustain the health system, pay for welfare measures, and support companies suffering the consequences of the pandemic. At the EU level, the policy response has included additional spending programmes financed by the issuance of common EU bonds and new asset purchases by the European Central Bank (ECB). Together with the extension of state-backed loan guarantees and moratoria, the crisis response measures have so far prevented a rise in non-performing loans and a marked deterioration in creditworthiness of borrowers.

This coordinated policy response has ensured macrofinancial stability, avoiding heightened market pressure on public finances and managing potential risks to bank balance sheets. The current economic context is thus different from the 2009 financial crisis, which escalated into a sovereign-debt crisis in 2011-2013, partly due to sovereign-bank feedback loop dynamics ([25]). At that time, several EU governments had to rescue banks with large amounts of public money, putting significant pressure on public finances, deteriorating their sovereign risk profile and affecting the value of banks' holdings of domestic sovereign debt. Given that EU banks had a strong home bias (i.e. they often bought the government debt of the countries where they were based), some banks required further help after the first government interventions. This added to public debt, generating a feedback loop. Since this time, significant regulatory action has been taken to restore confidence in the financial sector, make banks safer and more resilient, and sever the direct links between banks and their domestic sovereigns, notably through a new bank recovery and resolution framework.

In this article, we explore in a stylised setting the impact of key EU measures in the areas of fiscal and monetary policy on reducing the risks associated with sovereign-bank loops in the context of the COVID-19 crisis. To this end, we: (i) employ the micro-simulation SYMBOL model coupled with a sovereign default risk model, ([26]) and (ii) use of bank-level data from the European Banking Authority (EBA) on sovereign exposures, expanding on the work in Bellia et al. (2019) ([27]). The analysis can thus be seen as providing an assessment of the effectiveness of the EU fiscal and monetary response to the

([25]) See Fontana A. and S. Langedijk (2019), 'The Bank-Sovereign Loop and Financial Stability in the Euro Area', *JRC Working Papers in Economics and Finance* 2019/10.

([26]) See De Lisa, R., S. Zedda, F. Vallascas, F. Campolongo and M. Marchesi (2008), 'Modelling deposit insurance scheme losses in a Basel 2 framework', *Journal of Financial Services Research*, Vol 40 and Kok C., S. Ongena, L. Pelizzon, L. Hordijk, D. Kancs, J. Cariboni, W. Heynderickx, S. Maccaferri, A. Pagano, M. Petracco Giudici (2018), 'Review of the SYMBOL model', *JRC Technical Reports* EUR 29233 EN. The sovereign default model is Mody, A. and D. Sandri (2012), 'The Eurozone crisis: how banks and sovereigns came to be joined at the hip', *Economic Policy* 27 (70).

([27]) Bellia M., L. Calès, L. Frattarolo, A. Maerean, D. P. Monteiro , M. Petracco Giudici and L. Vogel (2019), 'The Sovereign-Bank Nexus in the Euro Area: Financial & Real Channels', *European Economy* discussion paper 122.

COVID-19 crisis in terms of enhancing the resilience of sovereigns and banks to a hypothetical banking crisis, while illustrating how this resilience has developed as EU initiatives moved from an initial to a more advanced stage.

We consider three scenarios in our simulations:

1. **a no EU intervention scenario:** this is a purely hypothetical scenario where no intervention is enacted at EU level along the monetary and fiscal dimensions, so that there is no new asset purchase programme by the ECB nor common EU bond issuance, and market pressure remains elevated with respect to the more vulnerable sovereigns;

2. **an EU intervention scenario, where no EU grants are contemplated:** this scenario takes into consideration the new and expanded asset purchase programmes of the ECB as well as EU bond issuances financing the Support to mitigate Unemployment Risks in an Emergency (SURE) and NextGeneration EU (NGEU) programmes, where the latter is assumed to be made up entirely of loans to Member States;

3. **an EU intervention scenario, where NGEU includes both loan and grant components:** this scenario is similar to scenario 2, while considering the fact that a share of NGEU financing to Member States is provided through grants.

The results are presented for the euro-area aggregate as well as for eight euro area (EA) economies (Belgium, Germany, Ireland, Spain, France, Italy, the Netherlands and Portugal), which together represent approximately 78% of EU GNI.

The remainder of this article is structured as follows. Subsection II.2 provides a timeline of the EU's response to the COVID-19 outbreak together with an analysis of changes in credit default swap (CDS) quotes. Subsection II.3 describes the different simulation scenarios and the modelling strategy. Subsection II.4 presents the simulation results and Subsection 0 concludes.

II.2. The EU response to the COVID-19 outbreak and CDS movements: a timeline

Graph II.1 provides a timeline of events related to the evolution of the pandemic crisis during the first half of 2020, while Graph II.2 shows developments in sovereign CDS spreads (five-year maturity) during the same year for our selection of eight EA countries.

Initially affecting the city of Wuhan in China, the COVID-19 outbreak was declared a public health emergency of international concern by the World Health Organization (WHO) on 30 January 2020. In Italy, the authorities ordered a lockdown and social distancing measures in its northern regions on 8 March and in the whole country on 9 March. It was the first Member State to adopt such measures. On 11 March, the WHO declared COVID-19 a pandemic. The severity of the outbreak soon became apparent all over Europe, with this recognition accompanied by sharp increases in CDS spreads.

On 12 March, remarks on the possible widening of government bond spreads during a press conference by President Lagarde of the ECB ([28]) failed to assuage market concerns over the degree of monetary policy support and possible constraints on Member State borrowing, triggering a negative reaction by the markets. Sovereign bond yields and CDS spreads increased substantially in several Member States, despite the announcement at the same time of a EUR 120 bn expansion in net purchases under the ECB's asset purchase programme (APP) until the end of 2020.

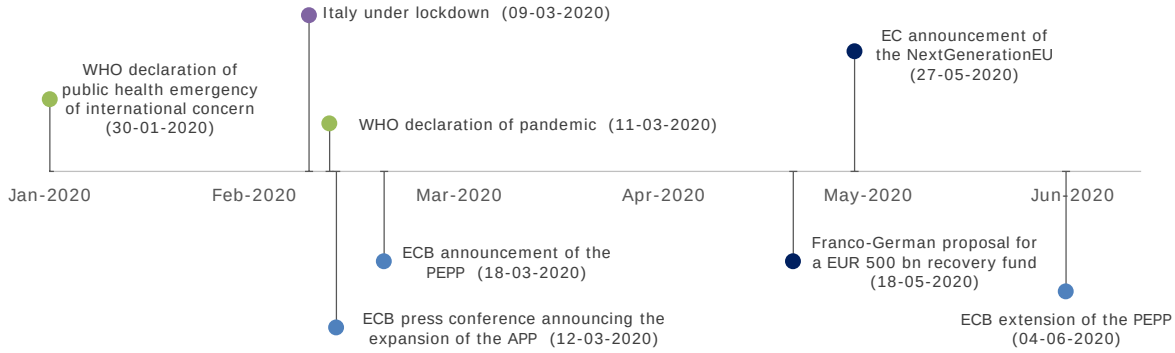
On 18 March, the ECB announced the pandemic emergency purchase programme (PEPP). The PEPP consisted of a temporary asset purchase programme of private- and public-sector assets with an overall size of EUR 750 bn ([29]), which provoked a positive market reaction. While CDS spreads slowly started to narrow following the announcement, the PEPP announcement does not seem to have been enough to ease price pressures in a sustained manner.

On 18 May, France and Germany advanced an ambitious proposal for a EUR 500 bn recovery fund to be distributed in the form of grants to

([28]) '…We are not here to close spreads. This is not the function or the mission of the ECB'. ECB press conference Q&A, available from https://www.ecb.europa.eu/press/pressconf/2020/html/ecb.is200312~f857a21b6c.en.html

([29]) Programme details are available from https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.pr200318_1~3949d6f266.en.html

Graph II.1: **Event timeline**



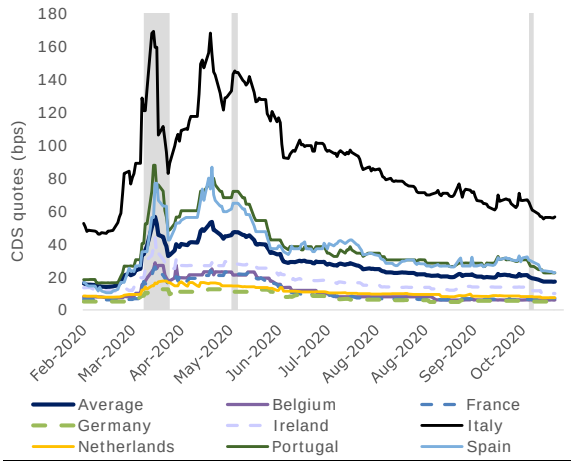
Source: Own presentation.

Member States. The fund would be backed by an increase in the EU's own resources ceiling and financed by joint EU debt issuance. On 27 May, the European Commission announced a recovery plan including a new instrument, NGEU ([30]). This instrument would allow the EU to borrow EUR 750 bn on financial markets and disburse the amounts to Member States in the form of grants and loans. Its aims were mainly to: (i) help Member States carry out investments and reforms; (ii) support the most affected private sector companies; and (iii) strengthen health security. The aforementioned Franco-German and NGEU proposals put CDS spreads firmly on a downward path

On 4 June, the size of the PEPP was increased by EUR 600 bn, resulting in a total of EUR 1 350 bn, available until at least the end of June 2021 ([31]). CDS spreads continued to decline, and stabilised from October 2020 onwards at their pre-crisis level. The second wave of contagion that occurred in most EU countries after the summer of 2020 does not seem to have affected their level, confirming that joint EU action was able to restore market confidence.

Given the difficulties of disentangling the effects of the ECB intervention from the effects of the European Commission's intervention, we consider the two jointly in our model simulations.

Graph II.2: **Changes in CDS spreads for selected EA Member States**



(1) The first shaded area corresponds to the period between 12 March and 26 March, the second to the date of the Commission spring 2020 forecast (6 May) and the third to the date of the autumn forecast (5 November 2020).
Source: Thomson Reuters DataStream.

II.3. Simulation scenarios and modelling approach

Simulation scenarios

All scenarios considered in the simulations are characterised by high government debt levels, which incorporate the large government financing needs brought about by the COVID-19 crisis, as projected in Commission services' forecasts. Fiscal measures are thus taken into account to the extent that they change debt levels, while their effect on

([30]) An overview of the European Commission response, including the SURE instrument worth EUR 100 bn, is available from https://ec.europa.eu/commission/presscorner/detail/en/ip_20_940.

([31]) ECB press release available from https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.mp200604~a307d3429c.en.html

The crisis response measures of the ECB went beyond asset purchases and included large liquidity injections, changes in collateral requirements and supportive supervisory policies.

growth is considered to the extent that it influences market perceptions (as reflected in CDS spreads).

The shock that is applied is the same across all scenarios and reflects a severe banking crisis ignited by losses on banks' private sector exposures (e.g. loan defaults). What differs across scenarios is the presence and nature of the EU crisis response, which will be seen to affect the resilience of sovereigns and banks to the hypothetical banking crisis.

As mentioned in Subsection II.1, we consider three scenarios. These are set out in the three paragraphs below.

1. **No EU intervention**: in this scenario, Member States finance their high debt levels exclusively through national bonds, with banks holding a proportion of these bonds in line with historical shares. The credit risk of Member States is relatively elevated and calibrated on the basis of CDS spreads observed for the period running from 12 to 26 March 2020, when no or limited EU-level intervention was expected by the markets.

2. **EU intervention, but no EU grants:** this scenario includes both the PEPP and the expansion of the APP programme ([32]) assuming that the Eurosystem acquires sovereign debt in the secondary market in proportion to the ECB capital key of the different Member States, thus reducing banks' sovereign exposures. In addition, EU bonds to finance the SURE and NGEU programmes ([33]) are introduced, and partly held by banks. EU issuance is considered riskless as it is guaranteed by all Member States, with the insurance cost distributed among countries according to a GNI key. In this scenario, sovereign risk is calibrated based on the CDS spreads observed on 6 May 2020, the day of the release of the Commission's 2020 spring forecast, a date when expectations by financial markets of common EU issuance were present, but the prospect of NGEU grants was still largely unpriced.

3. **EU intervention, with NGEU grants**: this scenario is similar to the previous one, with a portion of the proceeds from EU bond issuance now transferred to Member States in the form of grants, which do not affect their government debt-to-GDP ratios. Member States receive grants based on the NGEU allocation keys and, so that grant-related EU debt is eventually repaid, see their contribution to the EU budget increase based on their GNI keys. The increased future contribution to the EU budget is translated in the model as an increase in the present value of sovereign debt. The difference between the NGEU allocation and the GNI contribution keys implies that the more vulnerable Member States receive a net positive contribution from the grants, while less vulnerable Member States tend to receive a net negative contribution. We calibrate the model in this scenario using the CDS spreads from 5 November 2020, the day of the release of the Commission's autumn forecast, a time when market expectations had already incorporated the presence of grants and the details of the NGEU allocation.

Modelling approach

The model is simulated based on data and market expectations taken at different points in 2020. More concretely, we assume that the projections for government debt ratios included in the 2020

([32]) The PEPP is a temporary, unconventional monetary policy measure introduced by the ECB in response to concerns about the effectiveness of monetary policy transmission in the context of the COVID-19 crisis. The PEPP is carried out in addition to the existing APP, for a total expected size of EUR 1 350 bn at the date of the calibration of the model. The PEPP includes purchases of private and public financial assets by the ECB. A major difference between the PEPP and the APP is that the APP includes securities issued by the Greek government as well as commercial paper of non-financial corporations. The benchmark allocation across Member States is the ECB's capital key, although purchases are executed with some degree of flexibility and according to market conditions. Only Eurosystem eligible counterparties are allowed to offer assets to be purchased. However, asset managers and other non-bank financial institutions can offer securities through eligible counterparties.

([33]) NGEU is an emergency European recovery instrument aiming to support public investments and reforms. The instrument has a maximum size of EUR 750 bn (2018 prices), broken down as follows:

- grants under the Recovery and Resilience Facility (RRF): EUR 312.5 bn

- loans under the RRF: EUR 360 bn

- grants outside RRF: EUR 77.5 bn

In addition, the EU institutions fast-tracked the introduction of an employment support scheme (SURE) to counter the negative effects of the crisis. Loans to Member States under the SURE programme amount to a maximum of EUR 100 bn. Together with the amounts planned under NGEU, total common debt issuance by the EU can reach a maximum of EUR 850 bn in the coming years.

Commission spring and autumn forecasts materialise, and that a particularly severe banking crisis erupts against such a high-debt background induced by the COVID-19 crisis. In line with previous simulations using the SYMBOL model, the severity of the banking crisis is set equal to that of the 2008 financial crisis.

We use the model to generate a feedback loop between valuation losses on banking assets and potential hikes in sovereign risk premia due to increases in the level of government debt. In particular, the initial model shock produces valuation losses that may lead to government-sponsored recapitalisation of failing banks. ([34]) Such recapitalisations increase government debt which lowers government bond prices and produces further valuation losses on banks' balance sheets. ([35]) Affected banks may in turn require further recapitalisation by the government, thus iterating the loop.

It should be noted that the analysis is a partial equilibrium analysis focusing on the direct links between the government and the banking sector, while abstracting from other economic interactions. In particular, the possible effects of changes in bank balance sheets on lending and the real economy are not considered (although they implicitly contribute to differentiate the three simulation scenarios via the different growth expectations embedded in CDS spreads observed at different moments in time). The outcome of the simulation is: (i) an estimation of the bank-originated losses falling upon the government sector via recapitalisation needs; ([36]) (ii) the final government debt levels of each country reflecting such losses; and (iii) the increase in sovereign risk premia resulting from the increase in government debt ratios, found at the new model equilibrium following the initial shocks. The main implication of the partial equilibrium approach is, however, that the impact of a banking crisis on economic growth is not considered.

The modelling approach, the model calibration and the related assumptions are discussed in detail in Box II.1.

II.4. Simulation results

The shock that triggers sovereign-bank loop dynamics across all scenarios is losses on banks' private sector exposures, as generated by the SYMBOL model. These represent a hypothetical financial crisis in a COVID-19-induced high debt context, of a severity similar to the 2008 crisis. Therefore, the simulated financial losses by banks should be understood as hypothetical and merely illustrative. They represent potential losses under very adverse conditions and pessimistic assumptions, both in terms of the magnitude of the shock and the ability of existing crisis resolution mechanisms to absorb this shock.

For these initial SYMBOL losses, the most affected country in our simulation is Ireland, to the tune of 6% of GDP, followed by France and Spain, as shown and discussed in Box II.1. Ireland, however, has the highest ratio of regulatory capital to GDP, which strongly mitigates the impact from the initial shock.

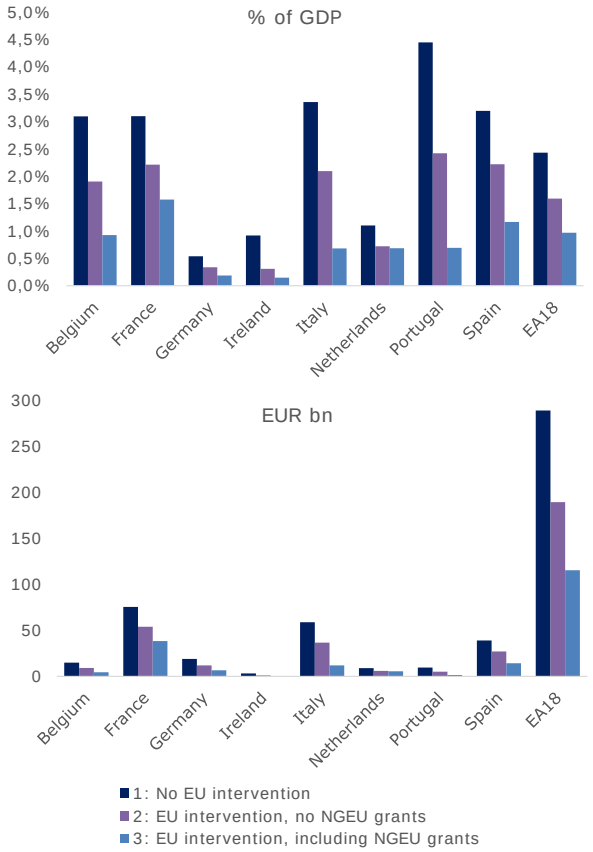
The feedback loop is set in motion through a sequence of knock-on effects that come from increases in sovereign debt (due to the recapitalisation of banks by the government) and valuation losses on sovereign debt held by banks (due to lower bond prices in connection with increases in sovereign debt ratios and risk premia). While the mathematical model underlying the simulations necessarily produces exact results, losses are better read in comparative terms rather than as absolute amounts, given the illustrative and hypothetical nature of the exercise. An overview of the results is presented in Graph II.3, where excess losses are defined as losses incurred by banks that bring their tier 1 capital ratio below an indicative minimum regulatory threshold of 10.5% after accounting for instruments that can be 'bailed-in'.

([34]) Such government interventions are regulated at EU level. In the present exercise, we avoid a discussion of the conditions and limits imposed on such interventions, and focus on abstract 'worst case' scenarios where banks lose market access and sovereigns effectively incur in expenditure due to bank recapitalisation. It should also be noted that model simulations contemplate a bail-in tool in the loss absorption cascade, but not the existence of a resolution fund. This can once more be interpreted as a pessimistic scenario where a resolution fund does not prevent the start of the feedback loop. A similar set-up was used in previous works such as Bellia et al. (2019) and Fontana and Langedijk (2019), *op. cit.*

([35]) The SYMBOL model assumes that due to market pressure mechanisms, all government exposures are *de facto* marked to market.

([36]) Given that the simulations are entirely hypothetical, these losses can be interpreted as contingent government liabilities.

Graph II.3: **Excess losses from a hypothetical financial crisis**



(1) EA18 refers to the results for the full EBA sample covering all EA Member States, except Slovakia.
Source: Own simulations.

Across the euro area, the combined excess losses could account for close to 2.5% of GDP in the no intervention scenario. These losses can be interpreted as additional financial liabilities of the public sector, i.e. they would need to be covered by government recapitalisation if a bank was to continue to operate under a minimum required capital ratio of 10.5%, assuming that no market recapitalisation was feasible. ([37])

The most affected Member State in this no intervention scenario as a share of its GDP is Portugal, and the least affected are Germany, Ireland and the Netherlands. Excluding Germany, all countries are exposed to potential losses that are close to or (well) above 1% of their GDP. Overall, the results are mainly driven not only by the country-specific shock sizes shown in Box II.1, but also by: (i) the initial riskiness of sovereigns (affecting the sensitiveness of risk premia to increases in debt levels); (ii) banks' matrices of exposures to the sovereigns; and (iii), bank capitalisation levels. All else being equal, sovereigns displaying higher initial risk premia and banks that are more exposed to their debt, or that enjoy lower tier 1 capital ratios, are more prone to experiencing excess losses.

The situation changes markedly once we include the effects of EU policy intervention, which lead to a substantial reduction in excess losses across all Member States. The simple average loss reduction is approximately 40% for the selected Member States in scenario 2 (NGEU without grants), increasing to approximately 67% if we also include a portion of NGEU grants (scenario 3). These average figures can vary significantly across Member States, with the highest loss reduction in scenario 3 belonging to Portugal (a decrease of 84%), closely followed by Ireland (84%) and Italy (80%).

The observed reduction in excess losses in connection with EU-level interventions can be interpreted as the result of several forces. Firstly, the interventions generate a positive confidence effect, which lowers the perceived initial riskiness of sovereigns, as captured by the CDS spreads used in the initial calibration of the model. This effect is strongest in scenario 3. Secondly, Eurosystem purchases and EU bond issuance help to de-risk bank balance sheets by effectively substituting central bank reserves and a safe EU asset for (risky) sovereign bonds. Thirdly, in the scenario with grants, the debt ratios of the most vulnerable Member States increase less compared with debt ratios of Member States with the largest fiscal space. This redistribution of sovereign risk across Member States carries positive financial stability implications, particularly given the non-linear impact of debt ratios on government creditworthiness in our model.

Table II.1 displays the change in debt-to-GDP ratios of the selected countries under the different scenarios. Concerning changes in the debt ratio, it is worth stressing that the feedback loop model used in the simulations does not capture growth, the provision of bank credit or other general equilibrium effects associated with the EU intervention. This means that the differences across scenarios relate only to the different impact of the sovereign-bank loop dynamics and to the

([37]) See also European Commission (2014), 'Assessing Public Debt Sustainability in EU Member States: A Guide', *European Economy Occasional Papers* 200, as well as subsequent debt sustainability monitors by the same institution.

different direct budgetary implications of EU intervention.

Table II.1: **Change in government debt-to-GDP ratios from a hypothetical financial crisis (pps.)**

Member State	1. No intervention	2. EU intervention without grants	3. EU intervention with grants
Belgium	3.2	2.2	2.4
France	3.1	2.5	2.7
Germany	0.7	0.7	2.4
Ireland	1.2	0.8	2.3
Italy	3.4	2.4	-0.9
Netherlands	1.1	0.9	2.6
Portugal	4.5	2.7	-3.9
Spain	3.2	2.4	-2.5
EA18	2.5	1.9	1.3

(1) Scenario 3 includes as part of government debt the additional contributions to the EU budget related to NGEU grants.
Source: Own simulations based on European Commission data.

The development of the sovereign debt ratio under a no intervention scenario is the result of the excess losses shown in Graph II.3. In scenarios 2 and 3, besides the respective excess losses, the debt ratio is also influenced by: (i) the possible presence of NGEU grants (which directly reduce the debt of beneficiary Member States, while indirectly increasing it via future contributions to the EU budget); and, to a smaller extent, (ii) costs associated with EU debt mutualisation (as discussed in Box II.1).

It can be seen that scenario 2 (EU intervention without grants) produces lower debt ratios when compared with a no intervention baseline. This is due to the effect of the EU intervention in reducing excess losses and the associated recapitalisation needs in domestic banking sectors. In the presence of an NGEU grant component (scenario 3), this positive effect becomes more marked for certain countries, with grant amounts more than compensating for excess losses (e.g. Portugal, Spain and Italy). At the same time, some Member States see their debt ratios increase more than before in present value terms. This is the case for countries allocated comparatively smaller EU grant amounts, while contributing significantly to the EU budget via their GNI key (e.g. Ireland, the Netherlands and Germany), reflecting the fact that the contributions of these countries are set to rise to repay the grant component embedded in EU bond issuance. Overall, given that grants reduce aggregate excess losses, they also reduce the government debt ratio of the euro area as a whole when compared with scenario 2.

As regards sovereign risk premia, these would tend to be higher in a no EU intervention scenario, reflecting both the relatively low levels of market confidence observed in the second half of March 2020, and the further stress on public finances from a full-blown banking crisis. However, the results reported in Table II.2 suggest that the EU intervention can produce a decrease across the board in sovereign risk premia, which becomes particularly marked once an NGEU grant component is included. This positive effect has to do with the EU intervention lowering government debt ratios, but also (and primarily) with the previously mentioned confidence effects that it generates, as also seen when discussing the evolution of CDS spreads in Subsection II.2. This effect benefits all Member States, including the least vulnerable countries who benefit both directly by partaking in the EU-wide reduction in initial CDS spreads, and indirectly via their bank exposures to the more vulnerable Member States, whose resilience is seen to improve.

Table II.2: **Sovereign risk premia under different scenarios**

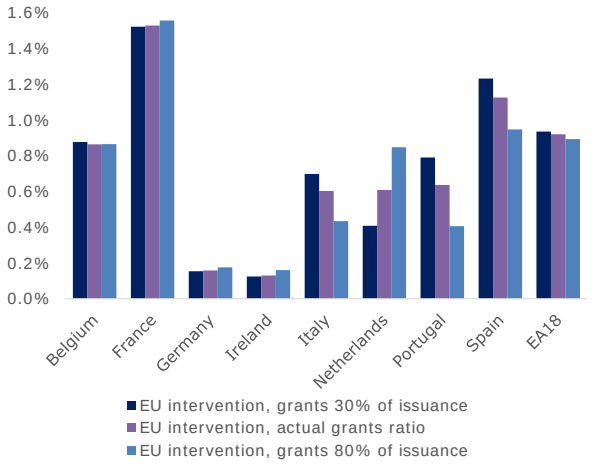
Member State	Five-year CDS spreads		
	1. No intervention	2. EU intervention without grants	3. EU intervention with grants
Belgium	27.0	21.2	6.0
France	24.4	21.9	6.2
Germany	12.5	11.0	5.0
Ireland	37.9	27.9	11.7
Italy	168.1	145.2	60.7
Netherlands	17.6	14.5	8.1
Portugal	87.9	72.1	26.5
Spain	66.6	64.8	29.3

Source: Thomson Reuters DataStream and own simulations.

Finally, we explore the effects of providing different shares of grants under the NGEU scheme. In particular, we consider two purely hypothetical scenarios where this share is set to 80% and to 30% of total EU bond issuance. This compares with a share of 46% assumed so far in

the simulations. ([38]) As can be seen in Graph II.4, increasing the share of grants tends to significantly decrease the amount of losses for those Member States with a grant allocation key that is higher than the EU budgetary contribution key (e.g., Portugal, Italy and Spain). At the same time, losses generally increase slightly for the other Member States (with the possible exception of the Netherlands, where the increase is more pronounced). For the euro area aggregate, although total excess losses do not vary much as a function of the share of grants, they appear to be minimised for higher grant ratios.

Graph II.4: **Excess losses for different shares of NGEU grants**



(1) EA18 refers to the results for the full EBA sample covering all EA Member States, except Slovakia.
Source: Own simulations.

II.5. Conclusion

A hypothetical banking crisis emerging from the COVID-19 downturn could have a considerable impact on EU banking systems via their exposures to sovereigns, and on sovereigns themselves via contingent liabilities linked to bank recapitalisation. Without policy interventions at EU level, hypothetical losses in a pessimistic scenario could be more than 2% of euro area GDP, with considerable variation at country level due to differences in baseline risk levels and in the size of the respective banking systems.

The introduction of EU bond issuance together with the Eurosystem asset purchases have a sizeable effect in reducing the potential impact of government debt hikes on banking sector stability. The effectiveness of EU bond issuance increases markedly when a part of the proceeds is distributed in the form of grants. In particular, the EU intervention package considered in this article – composed of Eurosystem asset purchases and of EU bond issuance under the NGEU and SURE programmes – reduces 'excess' bank losses in a systemic crisis by an average effect of about 40% in a scenario where no NGEU grants are included. With the introduction of grants, this reduction increases to 67% on average, with some countries experiencing reductions of more than 80%. Sensitivity analysis performed by introducing different shares of grants suggests that higher shares can have a modest beneficial effect on the euro area aggregate from a sovereign-bank loop viewpoint.

([38]) A 46% share was obtained by dividing the maximum amount of grants under NGEU (EUR 390 bn) by the maximum amounts of funding contemplated under the NGEU and SURE programmes (EUR 750 bn and EUR 100 bn, respectively).

Box II.1: Modelling approach, calibration and assumptions

The analysis in this section relies on the SYMBOL model of bank portfolio losses combined with a simple model of sovereign default introduced by Mody and Sandri (2012) ([1]), which are used together to generate a loop between bank losses and sovereign risk.

The methodology consists of four main steps: 1) calibrating model parameters; 2) simulating the impact of an exogenous credit-quality shock on the valuation of bank assets (this step is performed using SYMBOL); 3) estimating hikes in sovereign yields due to increases in government debt caused by bank recapitalisation, using the sovereign risk model by Mody and Sandri (2012); and 4) the continuation of the feedback loop until a new equilibrium is reached (i.e. until banks no longer need recapitalisation and government debt prices stabilise).

Table 1: **Government debt for selected EA Member States**

Member State	Government debt 2019 (EUR bn)	Government debt ratio 2019 (% GDP)	New government debt issuance 2020+2021 - spring forecast (EUR bn)	New government debt issuance 2020+2021 - autumn forecast (EUR bn)
Belgium	467	98	65	105
France	2380	98	355	499
Germany	2057	60	484	427
Ireland	204	57	28	31
Italy	2410	135	286	393
Netherlands	395	49	74	121
Portugal	250	117	17	31
Spain	1189	96	201	302

Source: European Commission's spring and autumn forecasts 2020.

Calibration of initial sovereign risk

Because the methodology requires choosing points in time for incorporating expectations that are used to assess baseline sovereign risk, we take the viewpoint of market participants at different moments in 2020. Government debt ratios are calibrated by adding projected government debt issuance for 2020 and 2021 to the 2019 government debt ratios (see Table 1). It should be noted in this connection that new government debt issuance for 2020 and 2021 was revised between the 2020 spring and autumn forecasts, and that this revision is incorporated into the model as a shock to the government debt-to-GDP ratio.

([1]) Mody, A. and D. Sandri (2012), 'The Eurozone crisis: how banks and sovereigns came to be joined at the hip', *Economic Policy* 27 (70).

CDS spreads another crucial input to the model. These spread make it possible to calculate of the implied initial probability of default for each Member State. ([2]) The three shaded areas in Graph IV.2 in the main text represent the three dates used in our model calibration, allowing us to incorporate market expectations at different points in time. The first shaded area represents the period between 12 March and 26 March during which the ECB press conference and the announcement of the PEPP took place. ([3]) The second and the third shaded areas represent the dates of the publication of the Commission's spring and autumn forecasts, which occurred on 6 May and 11 November 2020, respectively. The two forecast publication dates represent different information sets as regards the nature of EU intervention, thereby allowing us to assess the evolution of the effectiveness of EU policies as far as the sovereign-bank loop is concerned. By the spring forecast, ECB intervention was firmly established, common debt issuance was on the table, but the presence of a grant component was considered uncertain. By the autumn forecast, common EU bond issuance was expected and additional details were confirmed, particularly the presence of grants.

Calibration of initial bank risk and sovereign exposures

Bank-level data used in the model calibration are based on the spring 2020 transparency exercise conducted by the EBA and published in June 2020, covering a total of 127 banks. ([4]) The main input variables for bank-level data are regulatory capital, total capital, risk-weighted assets (RWA), total assets and a matrix of sovereign exposures for each bank. Variables aggregated at country level are scaled up to reflect the total size of the domestic banking sector of each Member State, based on data on total banking assets for each Member State provided by the ECB. Bank-level variables influence the simulated gross SYMBOL losses, which represent the shock applied to our model.

([2]) We choose a five-year time horizon for CDS spreads given that the effect of NGEU and other policy interventions is likely to be concentrated in this period, which is also the time interval when government debt ratios are likely to peak (and thus when sovereign risk will arguably be highest). Moreover, the five-year CDS is the most liquid and responsive CDS contract.

([3]) We use the maximum CDS value for this period, excluding values that exceed the 99th percentile of the distribution of each series, as computed over the latter's entire sample.

([4]) See https://eba.europa.eu/risk-analysis-and-data/eu-wide-transparency-exercise

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Box (continued)

These simulated gross SYMBOL losses are the initial losses on private sector assets held by banks that set in motion the sovereign-bank loop. ([5]) Key banking sector data are presented in Table 2.

Table 2: **Key banking sector data**

Member State	No. of banks in sample	Total bank assets / GDP	Regulatory capital / GDP	RWA / Total bank assets	Gross SYMBOL losses / GDP
Belgium	6	212%	15%	26%	2.4%
France	8	364%	22%	33%	5.8%
Germany	15	226%	13%	36%	2.8%
Ireland	3	317%	35%	56%	6.2%
Italy	11	205%	16%	45%	3.7%
Netherlands	5	286%	21%	25%	3.6%
Portugal	5	184%	17%	57%	3.8%
Spain	12	212%	14%	44%	4.3%

(1) Values are scaled up as needed to reflect the size of the domestic banking sector of each Member State.
Source: EBA, ECB, own calculations.

Table 3 shows the matrix of sovereign exposures at year-end 2019, expressed as relative holdings compared to the total holdings summed across the eight countries under analysis. The shaded diagonal highlights the strong degree of home bias evident in all countries.

Table 3: **Pre-COVID-19 matrix of sovereign exposures for selected Member States**

Member State	BE	FR	DE	IE	IT	NL	PT	ES
BE	48%	13%	2%	2%	23%	2%	5%	7%
FR	5%	75%	6%	1%	8%	1%	1%	4%
DE	2%	6%	73%	1%	11%	2%	1%	4%
IE	6%	7%	1%	66%	5%	1%	3%	13%
IT	1%	3%	7%	0%	76%	0%	1%	13%
NL	18%	6%	17%	0%	0%	54%	0%	5%
PT	0%	2%	0%	2%	14%	1%	65%	18%
ES	0%	1%	1%	0%	15%	0%	5%	79%

(1) As at year-end 2019. The first column identifies the banking sector holding the exposures while the first row identifies the sovereign counterpart. Percentages are calculated for the eight Member States shown in the table, so that each row adds up to 100%.
Source: EBA, own calculations.

The 2019 sovereign exposure matrix is updated according to assumptions that seek to capture the impact of COVID-19 on new government debt issuance and how this debt is absorbed by the banking system. ([6]) Generally speaking, we assume that banks absorb newly issued debt (as per the 2020 and 2021 financing needs shown in Table 1) in proportion to their existing bond holdings. In the no intervention scenario, national banking sectors increase their sovereign exposures by between 10% and approximately 21%, depending on the country concerned, as reported in Table 4. These figures represent the additional amount of sovereign debt that each bank has to buy to participate in the absorption of the new debt issued by the Member States.

Table 4: **Change in bank sovereign exposures with and without EU intervention (% change with respect to 2019 levels)**

Member State	Without EU intervention	With EU intervention
Belgium	14%	-8%
France	15%	-6%
Germany	21%	-1%
Ireland	14%	-9%
Italy	13%	-10%
Netherlands	18%	-3%
Portugal	10%	-21%
Spain	16%	-20%
Simple average	15%	-10%

Source: Own calculations.

In the other two scenarios, we assume that the Eurosystem will absorb under the PEPP and the APP up to around EUR 1 350 bn of sovereign debt, consistently with the information set available at the dates chosen for the model calibration. In addition, we assume the presence of an EU bond as a source of indirect financing for Member States. ([7]) These two features result in a reduction of bank exposures to individual Member States, and in new exposures to EU bonds. The reduction in sovereign exposures reflects the relative size of EU bonds outstanding and Eurosystem purchases in excess of government financing needs, both of which are proportionally applied to banks' exposure matrices. In all cases, bonds acquired from banks by the Eurosystem are

([5]) It may be worth noting that the differences in SYMBOL losses as a percentage of GDP are driven by differences in the relative importance of national banking sectors (as measured by bank assets/GDP) and by differences in their initial riskiness (as measured by RWA/total assets).

([6]) This modification does not constitute a shock in the model, but rather sets the initial exposure conditions.

([7]) Although the NGEU funds will be distributed in different payments over the coming years, we assume that the model captures the medium-term effects of this policy, and thus we include the entire EU bond amounts in our calculations.

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Box (continued)

considered to be ultimately converted into reserves with the central bank, which are risk-free assets.

Since the simulations take the viewpoint of 2020, the assumptions in each simulation seek to be consistent with the information available at that time. In particular, the NGEU total amounts and allocation keys rely on information published in 2020 and on the assumption of full use of the facility (see Table 5 for the NGEU allocation keys, which are assumed to be identical to those of its main component, the RRF). While these assumptions are merely illustrative, they can be understood as representing a case where common issuance reaches its full potential (i.e., all available loans are taken up). We also estimate the gross financing needs of individual Member States for 2020 and 2021 and, if funding provided under NGEU is higher than those funding needs, we assume that the surplus replaces or reduces the existing stock of debt.

Table 5: **Upper bound for EU bond mutualisation costs for selected EA countries**

Member State	RRF keys	GNI Weights	EU bond proceedings (bn)	CDS price (per EUR 1MM)	Gross cost of mutualisation (EUR bn)
Belgium	1.7%	4%	14.5	20 060	0.49
France	11.6%	23%	98.6	18 106	2.58
Germany	7.6%	27%	64.6	13 034	3.68
Ireland	0.3%	2%	2.6	26 805	0.28
Italy	20.4%	17%	173.4	113 989	1.88
Netherlands	1.8%	5%	15.3	21 025	0.85
Portugal	4.1%	2%	34.9	54 346	0.22
Spain	20.6%	11%	175.1	51 437	1.30

Source: Own calculations based on five-year CDS quotes from Thomson Reuters DataStream; projected RRF keys based on the Commission's autumn 2020 forecast.

Calibration of mutualisation costs

We assume that EU bonds are risk-free, so that they will not contribute to the riskiness of banks' balance sheets, but will increase the debt-to-GDP ratios of Member States to the extent that they receive an EU loan or need to contribute to the repayment of the grant component. Changes in the risk of default in each country are driven by the changes in its debt-to-GDP ratio (as per the Mody-Sandri model), which includes the costs of mutualisation of the potential losses on the common debt instrument.

To quantify this implicit cost of guaranteeing joint EU debt issuance against default cost, we determine the credit and budgetary claims of the EU with respect to each individual country. This allows us to compute the expected losses on total EU exposures as the sum of the expected losses on the exposures to each Member State. Total expected losses are then assumed to be guaranteed by Member States, ([8]) with each country liable only to the extent determined by its GNI key. ([9]) This calculation can be understood as providing a conservative upper bound to the (expected) costs of mutualisation, which does not take into account possible diversification gains from pooling together sovereign risk under a EU bond. The cost for the individual Member States is presented in Table 5 and, in the context of the simulation model, is considered to affect the debt-to-GDP ratio and a Member State's riskiness in the same way as new debt. This cost is seen to be of minor macroeconomic significance compared to the magnitude of EU bond issuance and additional government financing needs.

Model shocks

Once the calibration is done, an initial shock is applied to the model, which is assumed to come from losses on banks' private sector exposures (e.g., loan defaults). The SYMBOL model estimates the distribution of such losses for financial crises of different severities. A crisis with a loss magnitude similar to the 2008 crisis is considered in this section. ([10]) A secondary initial shock is also applied to government reflecting the revision in the expected evolution of the government debt ratio between the 2020 spring and autumn forecasts. This shock improves the comparability of the results across the three scenarios.

([8]) Expected losses have a direct correspondence to CDS premia, where we calculate the market value of a hypothetical CDS based on the (EU claim-based) weighted average sovereign CDS quotes observed from 5 June to 24 June 2020 with a coupon equal to 1 bps (thus assuming no coupon payments to have a 'one-shot' price) for EUR 1 MM. During the aforementioned period, there was already the expectation of a large increase in government debt, but no certainties about partial debt 'mutualisation' via the EU budget.

([9]) The GNI share is the variable that is used to calculate the contributions of Member States to the EU budget, which is the basis for providing the debt service on EU bonds. As such, we are implicitly assuming that in the event of a Member State defaulting on an EU loan (or on another financial obligation towards the EU), all Member States would be called upon to fill this financial gap and honour the EU's debt obligations based on additional contributions to the (GNI key-based) EU budget.

([10]) Crisis severity is assessed by the probability of the crisis occurring. Actual losses in excess of capital will be different under current conditions when compared to 2008 given the de-risking and capital increases that took place in the banking system in recent years.