

2022

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### Recommended Citation

Sánchez Serrano, Antonio (2022) "From Lost Turnover to Nonperforming Loans: The Impact of the COVID-19 Pandemic on the Economy and on the Financial System," *Journal of Financial Crises*: Vol. 4 : Iss. 3, 99-164.

Available at: <https://elischolar.library.yale.edu/journal-of-financial-crises/vol4/iss3/3>

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# From Lost Turnover to Nonperforming Loans: The Impact of the COVID-19 Pandemic on the Economy and on the Financial System

*Antonio Sánchez Serrano*<sup>1,2</sup>

## Abstract

The COVID-19 pandemic created an unprecedented economic shock across the world. As a result of the coronavirus outbreak and the related health measures, nonfinancial corporations providing nonessential goods or services that cannot be consumed remotely have experienced a large decrease in their turnover. Using balance sheets and flows statements, we are able to quantify the impact of the pandemic on nonfinancial corporations and households, according to several scenarios for the pandemic over 2021. The impact is largely heterogeneous across sectors and amounts to up to 20% of the turnover for euro area nonfinancial corporations. Stress in these corporations and households can spill over to banks in the form of nonperforming loans (NPLs). The size and targeted nature of government support as well as the financial soundness (that is, net worth) with which economic agents entered the pandemic define the amount of NPLs that arise. Based on our estimates, the increase of NPLs seems limited, also when considering second-round effects from corporate insolvencies (about 5% to 7% of total loans). However, in certain cases, when banks are only slightly above the minimum prudential requirement of the leverage ratio, their solvency position may be threatened.

**Keywords:** government support, net worth, nonperforming loans, pandemic

**JEL Classifications:** G21, G33, G51, H12

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<sup>2</sup> Disclaimer: The views expressed in this paper are those of the author and do not necessarily represent the views of the European Systemic Risk Board (ESRB), any of its member institutions, or the ESRB Secretariat. Comments by colleagues at the ESRB Secretariat, by Javier Suarez, and by anonymous referees are kindly acknowledged. All remaining errors are the author's.

## I. Introduction and Motivation

In the early months of 2020, a virus originating in China spread across the world, driving the coronavirus disease (COVID-19) toward the most severe pandemic in this century. Before this event, little attention was paid to the economic consequences of pandemics. Two pioneering papers, written in the context of the SARS (severe acute respiratory syndrome) outbreak in 2005, are worth noting. McKibbin and Sidorenko (2006) develops a model considering the consequences of a flu-like pandemic on the global economy under different scenarios and finds that a pandemic similar to the Spanish flu would cause a drop of real GDP exceeding 10%. The US Congressional Budget Office (US CBO 2005) undertakes a similar exercise, and its severe scenario implies a GDP drop close to 5%.

The nature of the shock the COVID-19 pandemic has caused is unprecedented and differs significantly from other episodes of crisis in peace times, such as the Global Financial Crisis (GFC) or the oil crisis in the 1970s. It is necessary to go back to the Spanish flu of 1918–1919 and to the Great Depression to find a similar shock to the world economy during peace years. Garrett (2007) looks at the response to the pandemic by different cities in the US in 1918–1919 and finds that those cities that went for a total lockdown suffered more severe economic losses in the short term (up to 50% in restaurants, for example) but were able to recover quickly. Cities that implemented partial lockdowns did not get any tangible results from these policies. De Santis and Van der Veken (2020) quantify a sizable impact of the pandemic in terms of output loss and macroeconomic risks, perceiving an increase in income inequality across countries. Barro, Ursúa, and Weng (2020) identify a decrease in GDP and in consumption of 6% and 8%, respectively, as a result of the Spanish flu pandemic. On the post-pandemic impact, Brainerd and Sieglar (2003) find a strong positive influence of the Spanish flu pandemic on growth in the subsequent 10 years. Going further into past similar shocks, Jordà, Singh, and Taylor (2020) study several pandemics (and wars) over history and conclude that the macroeconomic effects of pandemics persist for about 40 years, with real rates of return substantially depressed, as there was no destruction of capital in previous pandemics (contrary to wars).

Since March 2020, international institutions, central banks, and the academic community have tried to forecast economic growth under the COVID-19 pandemic, based on models developed to take into account the specific functioning of an economy subject to a contagious virus. The magnitude of the economic recession the COVID-19 pandemic has caused is found to be particularly significant (ECB 2020; IMF 2021). The COVID-19 pandemic shock is somehow unique. Differently from “typical” financial shocks, it did not originate in the financial system and is affecting all countries to a certain extent (the GFC, by contrast, did not substantially affect emerging economies). Each national economy has been hit by the pandemic with a different degree of resilience and subject to different vulnerabilities. The ultimate economic impact of the COVID-19 pandemic accordingly depends on these two factors, which also interrelate closely with the combined policy response, in terms of committed and potential fiscal space of governments.

The outbreak of the COVID-19 pandemic has spurred an intense research effort in the academic community to understand the nature and size of the shock it caused. With no purpose of being exhaustive, we can highlight the findings of McKibbin and Fernando (2020), which models seven scenarios for the evolution of the pandemic and assesses their impacts on GDP. Even the milder scenarios could significantly affect the global economy in the short term, with more severe scenarios leading to negative GDP growth rates of about 10% in the first year after the pandemic outbreak. Battistini and Stoevsky (2020) considers the impact across the main sectors of nonfinancial corporations and finds large heterogeneity across them, although with a bleak picture overall. Carletti et al. (2020) finds that a three-month lockdown could decrease profits of nonfinancial corporations by 10% of quarterly GDP. The authors identify more frequent distress in small and medium-size enterprises (SMEs), in highly leveraged nonfinancial corporations before the pandemic, and in the manufacturing and wholesale trade sectors. Boissay and Rungcharoenkitkul (2020) takes stock of the existing literature and of the latest forecasts regarding the impacts of the COVID-19 pandemic. Gourinchas et al. (2020) uses a model to estimate the impact of the COVID-19 pandemic on business failures among SMEs in 17 countries using firm-level data. In the absence of government support policies, failures are expected to increase significantly, although they should not threaten the aggregated solvency position of banks.

More recently, Mojon, Rees, and Schmieder (2021) also finds substantial losses in the sectors most affected by the pandemic, but these do not translate into large corporate credit loss rates, because the most affected sectors account for a smaller share of borrowing by nonfinancial corporations than during the GFC. Ebeke et al. (2021) simulates the relief provided by government measures to a sample of 4 million European nonfinancial corporations. Assuming different sectoral shocks, the authors find these measures to have been effective in mitigating job destruction and liquidity issues. The focus of Aiyar et al. (2021) and the Organisation for Economic Co-operation and Development (OECD 2021) is on whether the European banking system would be able to absorb the expected increase of nonperforming loans (NPLs). In both cases, the answer seems to be positive, without excluding some potential difficulties of certain banks breaching the requirement for the maximum distributable amount, in particular for hybrid forms of capital.

What emerges from the analyses above is that the COVID-19 pandemic is generating substantial economic losses, which would need to be absorbed by one or various economic sectors at some point. In this regard, governments' policy measures (such as debt moratoria, loan guarantees, and other initiatives of a fiscal nature) can be seen as allocating these economic losses across sectors (for example, loan guarantees imply a share of possible future credit losses between banks and governments) and over time (for example, loan moratoria may provide some relief to borrowers in the repayment of their loans).

In this paper, we contribute to the effort to quantify the impact of the COVID-19 pandemic by using an approach based on stylized balance sheets and inflows and outflows for each economic sector. The ultimate objective is to gauge the degree to which different economic agents are differently affected and whether the banking system, as main lender for nonfinancial corporations and households, could absorb the related losses. Our paper places

itself close to Gourinchas et al. (2020); Aiyar et al. (2021); Mojon, Rees, and Schmieder (2021); and the OECD (2021).

At this stage, it is important to make a methodological clarification. We do not consider cash flows but rather inflows and outflows. Cash flows require that cash (or cash equivalents) enter or leave the economic agent and, as such, do not include changes in valuations of financial assets or changes in pension liabilities. These are important wealth channels for households, and we want to consider them in our paper as well. Therefore, our inflows and outflows are close to the concept of “economic flows” used in national accounts. According to the United Nations (UN) System of National Accounts, “economic flows” reflect the creation, transformation, exchange, transfer, or extinction of economic value; they involve changes in the volume, composition, or value of an institutional unit’s assets and liabilities (UN 2009).

We provide answers to four important questions related to the shock the COVID-19 pandemic has caused: (1) which sectors of activity are most affected by the pandemic, and what do these findings imply in terms of cross-country asymmetric impacts; (2) how much can nonfinancial corporations and households lose as a result of the pandemic, and how does the evolution of the pandemic determine these losses; (3) what do these losses mean for solvency of the real economy in the coming months, and which portion of these losses can become NPLs on banks’ balance sheet; and (4) given their current (non-risk-weighted) capital levels, the capacity of banks to absorb losses triggered by NPLs. Looking at available data for the euro area (cutoff date for our analysis is the second quarter of 2021) and drawing on the accounting information for each economic sector, we provide an estimate of the magnitude and shape of the shock the COVID-19 pandemic caused. These estimates should not be seen as accurate predictions but rather as an indication of the size of the issues at stake.

The COVID-19 pandemic has affected the inflows of economic agents (for example, through a reduction in sales of nonfinancial corporations), resulting in large negative changes in their net worth. These negative changes in net worth may translate into solvency issues, as the balance sheets of economic agents may deteriorate to the point of putting their long-term financial sustainability into question. Despite the development of vaccines, it has increasingly been recognized that it may take almost two more years to overcome the COVID-19 pandemic and that its effects may be more structural in terms of changes in global production processes or changes in preferences of economic agents than initially thought.<sup>3</sup> Furthermore, the COVID-19 pandemic shock is also affecting existing economic relationships in both the real economy and the financial sector, such as those related to organizational capital, human capital, and the provision of credit. A long-lasting disruption in these economic relationships could have permanent and severe effects, hampering the growth path over the long term. In other words, there is still a lot of uncertainty about the long-term

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<sup>3</sup> For example, a decline in investment, if temporary, may not have permanent consequences for technological development, but an extended period of low investment would have serious effects on innovation and (potential) growth.

structural “scars” left by the pandemic on economic activity, a relevant topic that falls, however, outside the scope of our paper.

This paper is organized as follows. The next section describes the four main economic sectors (nonfinancial corporations, households, financial intermediaries, and government), and the third section discusses how the COVID-19 pandemic (or any virus-driven pandemic, in general) impacts the balance sheet and the inflows and outflows of the first two of these sectors. Section IV deepens the analysis by estimating the impact of the COVID-19 pandemic under several scenarios and provides estimates of NPLs generated by the pandemic. Section V considers whether the banking sector may be resilient enough to absorb the related impact, based on the excess own funds from the binding prudential leverage ratio requirement. Section VI concludes. Several appendixes provide additional information on our analysis.

## II. A Stylized View of the Main Economic Sectors

We start with an economy composed of four sectors: households, nonfinancial corporations, financial intermediaries, and the government. For clarity, we do not consider the external sector or banks, insurers, pension funds, and investment funds separately, but as part of the same sector (financial intermediaries). Each of these sectors has a balance sheet with assets and liabilities (including net worth as the difference between assets and liabilities), and it is subject of inflows and outflows. The difference between them determines the changes in net worth. Net worth is a central concept in our assessment of the economic impact of the COVID-19 pandemic. It is indeed a fundamental variable to understand the allocation of credit in an economy as well as the channels through which shocks can be amplified or extended over time (Kiyotaki and Moore 1997).<sup>4</sup>

The balance sheet of each sector is considered on a consolidated basis and is described in further detail in the paragraphs below. Appendix A complements this information, adding data for the whole euro area as of the end of 2019. We consider the most relevant items in terms of size, interconnections with other sectors, and impact of the COVID-19 pandemic and the related policy measures.

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<sup>4</sup> In the case of bank lending, a reduction in the value of durable assets diminishes the net worth of the economic agent, resulting in a lower value of assets available to be used as collateral in loans. Borrowers’ credit limits are determined by assets to be pledged as collateral: the higher these assets, the higher the borrower’s lending possibilities. In economic crises, the interaction between credit limits and asset prices multiplies the initial shock because of reduced credit and reduced asset values. In general terms, the higher the net worth of a potential borrower, the less pronounced are agency problems in the form of moral hazard and adverse selection. A reduction in net worth thus aggravates agency problems, and the resulting frictions might negatively affect entire segments in the financial markets. This holds true particularly if economic agents are hit by an aggregate shock that is beyond their control and if standard sorting and screening mechanisms focused on idiosyncratic risks reach their limits. In the field of monetary policy, Bernanke and Gertler (1995) stress the potential impact of changes in monetary policy on borrowers’ balance sheets and income statements, including variables such as net worth, cash flows, and liquid assets.

*Households.* Their balance sheet comprises real estate, financial assets, pension rights, and other assets on the assets side, and mortgages, other loans, and future tax liabilities on the liabilities side. Households receive inflows from their work (wages), interest and dividends from the financial assets they own, and transfers from the government (such as unemployment benefit or pensions). Their main outflows are consumption, taxes, and the repayment of mortgages and other loans. The difference between their inflows and outflows can be seen as their savings for the period, affecting their net worth on the liabilities side of their balance sheet.

*Nonfinancial corporations.* Their main assets are fixed assets, inventories (only in case of industrial nonfinancial corporations), receivables, financial assets, and cash. On the liabilities side, they have loans from banks, bonds, payables to suppliers, pension obligations, future tax liabilities, and shares and other equity. In terms of inflows, the main sources are sales (comprising sales of final products, the provision of services, sales of intermediate products to other nonfinancial corporations, and public consumption), funding for investment, and transfers from governments (for example, grants). Their main outflows are wages, depreciation of fixed assets, interest on loans and bonds, and dividends paid to shareholders. The difference between inflows and outflows can be seen as the profit for the period.

*Financial intermediaries.* They have loans, bonds, and shares in the asset side of their balance sheet, and deposits, technical reserves, pension obligations, bonds, and shares and other equity on the liabilities side. The composition of the balance sheet reflects the heterogeneity of business models and institutions considered in this sector.<sup>5</sup> As inflows, the main ones are interest from mortgages and other loans, dividends from their holdings of shares, insurance premia, and net valuation gains (which include gains from trading with financial assets, asset management fees and other fees). Their main outflows are wages, interest on deposits and bonds, loan losses, insurance claims, and dividends paid to their shareholders. As with nonfinancial corporations, the difference between inflows and outflows is the profit for the period (or the change in net wealth).

*Government.* Its balance sheet reflects the present value of fees and taxes to be collected, fixed assets, and shares on the asset side, and pension rights, bonds, and other liabilities on the liabilities side. The main inflow government takes is the flow of taxes and fees, which depends on the overall level of economic activity. Its main outflows are interest on bonds, wages, public consumption, public investment, and transfers to households and nonfinancial corporations. The difference between inflows and outflows generates a deficit when it is negative (which would then need to be funded with sovereign debt) and a surplus when it is positive.

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<sup>5</sup> Like nonfinancial corporations, financial intermediaries could also have fixed assets and real estate on the asset side of their balance sheet, particularly insurance corporations and pension funds. We do not consider them, for the sake of simplicity.

### **III. The Impact of the COVID-19 Pandemic on Nonfinancial Corporations and Households**

This section provides a stylized view of the impact of the COVID-19 pandemic and the related health measures on nonfinancial corporations and households. The findings can also be applied to other pandemics driven by a contagious virus or pathogen. For completeness, the impacts on the government sector and on the external sector are briefly described in Appendix B.

#### **A. Nonfinancial Corporations: A Reduction in Revenues from Lower Consumption**

Following the outbreak of the COVID-19 pandemic, strict health measures were put in place (and some are still in place) to contain the spread of the virus and alleviate the stress in health infrastructure. However, such measures (many of which restrict the mobility of the population) have led to an important reduction in economic activity. On top of that, households have also adjusted to the risk of infection and have considered changes in their behavior in relation to social distancing (for example, in their leisure activities).

The first immediate consequence of the COVID-19 pandemic and of the related health measures limiting movement of populations has been a sharp reduction in consumption (Battistini and Stoevsky 2020; CCSA 2020; Kohlscheen, Mojon, and Rees 2020). An increase in precautionary savings in response to the uncertainty about the future has also been observed. The reduction of consumption has been particularly acute in nonessential goods and services that cannot be consumed from home (for example, cars or traveling). That is an important distinction to be made, as the consumption of essential goods and services (for example, food) has not been reduced. There is also a third category of goods and services for which consumption may have increased: those that are both nonessential and can be consumed from home (for example, online TV). The impact of the pandemic is more acute in the first category and more nuanced in the other two.

Furthermore, there is a differential impact in the case of nonfinancial corporations providing services or producing goods. Nonfinancial corporations providing services are not able to recover the services not provided during the pandemic (meaning a loss for the whole economy) while industrial sectors may recover their lower sales with higher consumption once the pandemic is over. Moreover, there can be disruptions in global supply chains, derived from the closing of borders, the discontinuation of the production of intermediate goods, and disruptions in transportation.

The decrease of consumption implies a sharp drop in the revenues of nonfinancial corporations. Based on their flows, nonfinancial corporations may react to the decline by increasing other sources of inflows or by decreasing some outflows. From the other two sources of inflows, capital inflows do not seem to have increased during the COVID-19 pandemic while transfers from the government have materially grown, as support to nonfinancial corporations has been one of the main policy targets of governments. Looking at outflows, temporary or permanent layoffs decrease wages paid and compensate the



reduction in revenues, while interest on loans and bonds seems more problematic to reduce. If we assume that dividends paid depend on the generation of profit and do not take place during the pandemic, and that the amortization of tangible goods is still going on, it seems difficult to avoid a sharp reduction in net worth of nonfinancial corporations. In a longer-term perspective, nonfinancial corporations can adjust to lower revenues through postponement of investments, a reduction of purchases from their suppliers, or with additional debt to cover working capital. Furthermore, as precautionary savings have increased, consumption decisions may be postponed until the pandemic is over. This decision is particularly important for sectors such as real estate, where the transaction price is high in comparison with the disposable income of households.

On that basis, we set the impact of the pandemic on nonfinancial corporations in sector  $s$  as a function of two factors: (1) whether the related good or service is essential, and (2) whether it can be consumed remotely.

If we assume a multiplicative relation,<sup>6</sup> we get:

$$IP^s = \frac{1}{ES^s \times RE^s} \quad (1)$$

where  $IP^s$  refers to the impact of the COVID-19 pandemic in sector  $s$ , and  $ES^s$  and  $RE^s$  are indexes measuring how essential the good or service provided by sector  $s$  is and how much it can be consumed remotely, respectively. Sectors with higher values of  $IP^s$  see a higher impact on their revenues, while sectors providing essential goods or services and those that can be consumed remotely are less affected.<sup>7</sup>

Moving from the sectoral impact to the impact on total nonfinancial corporations, we compute the weighted average of the impacts in different sectors:

$$IP^{NFC} = \sum_{s=1}^S IP^s \times \frac{GVA^s}{\sum_{s=1}^S GVA^s} \quad (2)$$

where  $IP^{NFC}$  denotes the impact of the pandemic on nonfinancial corporations in a given economy,  $IP^s$  is the impact of the pandemic in sector  $s$  and  $GVA^s$  refers to the gross value added of sector  $s$ , which is used to compute weights of the different sectors in an economy.

A third factor to consider in the computation of the impact of the COVID-19 pandemic on nonfinancial corporations, which is missing from Equation 2, refers to how each sector is interconnected with others: the more interconnected a sector is, the stronger the spillovers to other sectors and the larger the potential impact on financial stability. For example, if real

<sup>6</sup> The impact with an additive relation would be dependent on the good or service being consumed remotely or being essential, while with a multiplicative relation, both conditions need to be met to have low impact. This explains our preference for a multiplicative relation.

<sup>7</sup> Particularly in the case of goods or services to be provided remotely, there can be substantial tensions within sectors, with nonfinancial corporations more apt to operate remotely gaining market share at the expense of those less developed from a technological point of view. In our analysis, we stop at the level of sector, not considering these intrasectoral tensions.

estate sectors are severely affected and found to have unaddressed vulnerabilities, the subsequent related shock can propagate to households (through a negative wealth effect) and to financial intermediaries (banks through collateral values and direct exposures, investment funds through the positions of real estate funds, and insurance corporations and pension funds through holding of real estate assets). For the purposes of our analysis though, we do not consider these second-round effects.

## **B. An Estimation of the Asymmetric Impact of the COVID-19 Pandemic on Nonfinancial Corporations**

To illustrate the heterogenous impact that the COVID-19 pandemic has had across the world, depending on the structure of national economies, we compute the impact of the pandemic according to Equation 2.

Starting with the identification of essential activities, we follow the approach by Del Rio-Chanona et al. (2020) and use the identification made by the Italian government in its decree of March 22, 2020 (Italian Government 2020).<sup>8</sup> Then, for the large sectors (at the level of one-letter NACE industry classification codes), we compute  $ES^s$  as the number of activities referred to as essential by the Italian government divided by the total number of activities in that sector. We use four-letter NACE codes for these purposes and exclude activities carried out by the public sector (O: public administration and defense; compulsory social security; P: education; Q: human health and social work activities), activities related to financial services (K: financial and insurance services), and those with an unclear economic relevance (T: activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U: activities of extraterritorial organizations and bodies).

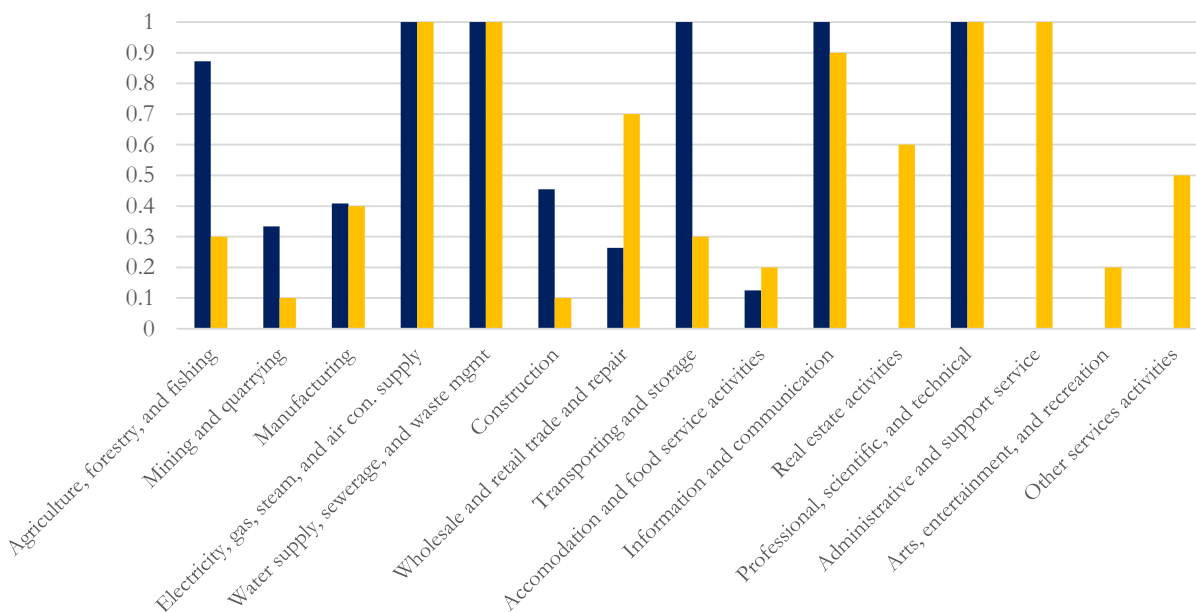
As a result, we compute an index of the degree to which each sector is essential for the economy, on a scale from 0 to 1, with higher values being associated with the sector being fully essential (Figure 1). We observe first an important heterogeneity, as together with several sectors performing essential activities (five of 15), four sectors obtain the minimum possible score.

To compute which goods and services can be provided and consumed remotely, we consider the degree to which it is possible for a potential customer to consume the good or service from home. We attribute a value of 1 to those sectors in which goods or services can be consumed from home without any need of substantial adjustments. Given the variety of activities included in the main NACE categories, the assessment made below in Figure 1 must be taken as an approximation, with an important role played by judgement.

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<sup>8</sup> The Italian government's decree of March 22, 2020, called for the suspension of productive activities, except for those sectors considered essential.

**Figure 1: Goods and Services Considered Essential (blue bars) and That Can Be Consumed Remotely (yellow bars)**



Notes: The blue bars show the ratio between the number of sectors mentioned as essential in the decree of the Italian government of March 22, 2020, and the total number of sectors, at four-letter detail, in each of the main sectoral divisions in the NACE code. Higher values represent that the sector is performing activities perceived as more essential. The yellow bars represent the degree to which the representative good or service provided by each sector can be consumed remotely in an easy manner.

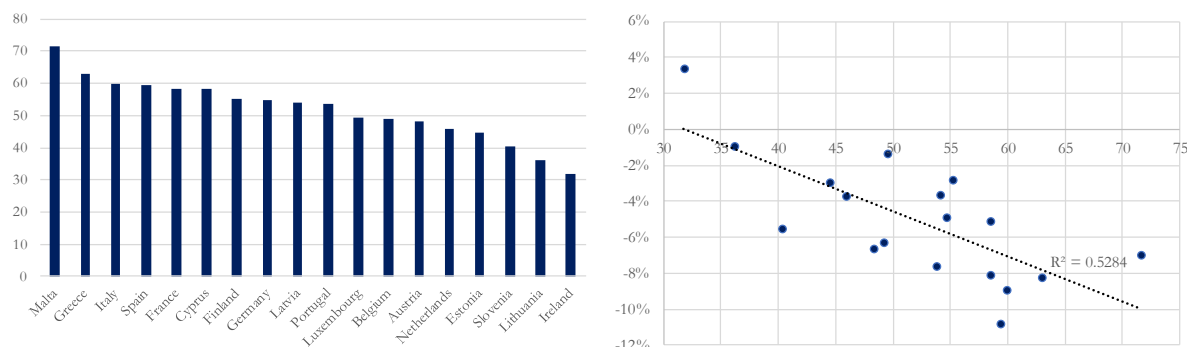
Sources: Italian Government 2020; author's elaboration.

To calculate the impact of the COVID-19 pandemic for each sector according to Equation 2, we replace those values of 0 for 0.01, to avoid getting undetermined expressions. Figure 28 in Appendix C shows the results per sector.

Given that the weight of the sectors in national economies varies across countries, the COVID-19 pandemic has had and will have an asymmetrical impact across countries. To illustrate this point, we use the data published by Eurostat on gross value added by NACE codes for the euro area economies at the end of 2019.<sup>9</sup> The left panel of Figure 2 shows the impact of the COVID-19 pandemic on nonfinancial corporations in euro area economies according to Equation (2), weighting the different sectors in terms of gross value added. There is substantial cross-country heterogeneity, as those countries most affected show an impact almost twice as large as countries least affected by the COVID-19 pandemic. The right panel of Figure 2 compares these impacts with the change in real GDP between the end of 2019 and the third quarter of 2020, finding a clear negative relationship.

<sup>9</sup> There are fewer sectors reported by Eurostat than in the main NACE categories. To compute Figure 2, we made some adjustments, as detailed in Appendix C.

**Figure 2: Impact of the COVID-19 Pandemic on Nonfinancial Corporations in the Euro Area**



Notes: The left panel shows the impact of the COVID-19 pandemic in each country, according to the impacts defined in Equation (2) and the weight of each sector in the national gross value added. The right panel compares this impact with the real GDP growth rate during the first three quarters of 2020 in volumes. No data for Slovakia.

Sources: Eurostat 2022a; author's elaboration.

### c. Households: Impact Determined by Wages and Consumption

In principle, only those households that have lost their jobs as a result of the COVID-19 pandemic can experience a large decline in their inflows while other households may be less affected and may even increase their net worth (and savings) in view of the lower consumption opportunities. Amid workers, those with a temporary contract (typically the positions with lowest remuneration and employing the younger generations) face the greatest risk of losing their jobs. Kaplan, Moll, and Violante (2020) finds that the hardest-hit occupations are those with relatively low flexibility in terms of substitutability with remote work and higher social contact intensity, which tend to be associated with relatively poorer individuals (in terms of both wage and liquid wealth). Del Rio-Chanona et al. (2020) classifies industries as essential or nonessential and constructs a Remote Labor Index, measuring the ability of different occupations to work from home.<sup>10</sup> Sectors such as transport are more likely to have output constrained by demand shocks while manufacturing, mining, and services are more likely to be constrained by supply shocks. Entertainment, restaurants, and tourism face both large supply and demand shocks. At the occupation level, the authors confirm that high-wage professions are relatively immune from adverse supply- and demand-side shocks while low-wage jobs are much more vulnerable.

To understand the impact of the COVID-19 pandemic on the household sector, it is necessary to consider also the potential loss of value of assets on the balance sheet of the sector.<sup>11</sup> The value of bonds and equities of nonfinancial corporations may decrease as a result of the fall

<sup>10</sup> Barrot, Grassi, and Sauvagnat (2020) offers a similar index but with a smaller breakdown by occupations.

<sup>11</sup> This dynamic appears also in the case of nonfinancial corporations, although with less intensity.

in consumption, affecting those households holding these financial instruments directly or indirectly (through investment funds or, more importantly, insurance and pension products). In addition to these securities, real estate is the largest asset on the balance sheet of households and is usually associated with a large liability (mortgage loans). A drop in the value of real estate can thus have dramatic consequences for the financial soundness of households.

Those households losing their jobs and facing limited unemployment insurance may witness a reduction of their inflows that is larger than their ability to reduce consumption of nonessential goods. In addition to existing unemployment benefits and the indemnities to be paid for the extinction of a labor contract, many governments have taken measures supporting workers in the form of shared payment of wages combined with temporal breaks in the work. Policy measures for households have been targeting the protection of those jobs at risk (through furlough or tax reliefs, for example) and the avoidance of default in loan repayments for the most vulnerable borrowers (essentially through loan moratoria).

In aggregated terms, the impact of the COVID-19 pandemic on households seems to operate in both directions. On the one hand, there is a decrease in wages deriving from the adjustments by employers in their workforces, but on the other hand, consumption is decreasing significantly, given the difficulty in maintaining previous levels of economic activity, and precautionary savings are increasing. Besides, accumulated net worth should be able to absorb losses derived from the COVID-19 pandemic. However, the aggregation hides the cross-sectoral heterogeneity of the financial soundness of households, as those with higher income tend to have higher net worth and be less indebted.<sup>12</sup>

We define the impact of the COVID-19 pandemic on households as a function of the share of workforce affected by the decrease in employment:

$$IP^H = \sum_{s=1}^S \frac{1}{ES^s \times RE^s} \times \frac{e^s}{e} \quad (3)$$

where  $IP^H$  refers to the impact of the pandemic on households,  $e^s$  is the number of employees in sector  $s$ ,  $e$  is the total number of employees in nonfinancial corporations, and  $ES^s$  and  $RE^s$  are indexes measuring how essential the good or service provided by sector  $s$  is and how much they can be consumed remotely, as defined in Section III.A.

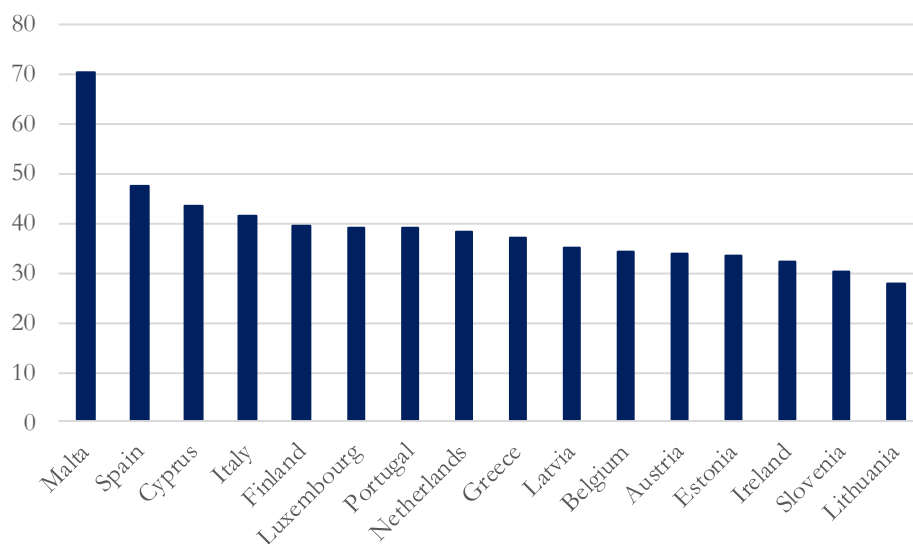
As a continuation of the example in the previous section, we use data on compensation of employees by sector as published by Eurostat to compute the parameter  $e^s$  and then calculate the impact of the pandemic on households across euro area countries, as per Equation (3). Figure 3 shows the resulting impact. Given the similarities between Equation (2) and Equation (3) (obvious, given the close interrelations between the financial soundness of

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<sup>12</sup> For a detailed analysis of the household sector in the euro area, please refer to Household Finance and Consumption Network (2020).

households and nonfinancial corporations through employment relations), the ranking of countries is very similar to the one in the left panel of Figure 2.

**Figure 3: Impact of the COVID-19 Pandemic on Households of the Euro Area**



Notes: The blue bars show the impact of the COVID-19 pandemic in each country, according to the impacts defined in Equation (3) on the basis of the compensation of employees reported for each sector of activity. No data for France, Germany, and Slovakia.

Sources: Eurostat 2022a; author's elaboration.

#### D. The Nature and Extent of Government Support

The COVID-19 pandemic, particularly as a result of the long period of reduced economic activity, has triggered an ambitious policy response by governments around the world since 2020. Government support measures have mainly targeted households and nonfinancial corporations, protecting their main sources of inflows (wages and sales). Loan guarantees are important to ensure that nonfinancial corporations keep their access to bank loans to meet their financing needs, which in a pandemic context could also cover their working capital. Loan moratoria seek to provide relief to those borrowers that have seen a substantial decline in their inflows by postponing the payments related to their bank loans. Other types of support measures comprise tax reliefs, equity injections, or direct grants to the most affected segments in the real economy. The other side of these ambitious support measures implies an increase in government deficits, which are expected to persist for some time.

In addition to government support measures, automatic stabilizers are at work to support the real economy during the crisis. For households, unemployment benefits provide inflows to workers who have lost their jobs as a result of the pandemic, and the lower generation of rents also imply that less taxes will be collected by the government. Nonfinancial corporations reporting losses for the year 2020 would not pay income taxes, for example.

Considering the stylized balance sheets and flows statements of our economy, it is worth noting that loan moratoria do not imply any expense or transfer for the government, as they represent a deferral of interest payments over time. Loan moratoria involve mainly banks and borrowers, with a small role played by the government. In the case of loan guarantees, the government needs to intervene only if the borrower defaults in its payments to banks. So, the transfer from the government to banks is conditional to the default event of the borrower. If the borrower does not default, there is no impact for the government. In addition to the automatic stabilizers, tax reliefs and direct grants do have an impact on government flows and increase its deficit. Equity injections also determine a transfer from the government to nonfinancial corporations, but in this case, the government takes a participation in the nonfinancial corporation (it owns it, at least partially), which can generate inflows, in the form of dividends, in the future.

In Europe, the European Banking Authority (EBA) and the European Systemic Risk Board (ESRB) have looked at the nature and uptake of the support measures taken by governments (EBA 2020a; ESRB 2021a). Loan guarantees have been used mostly by nonfinancial corporations while loan moratoria have benefited borrowers in the household sector in a larger proportion than nonfinancial corporations. Large heterogeneity in the design of the measures across countries, also reaching the uptake of them, has been observed. While cross-country differences may seem small (for example, loan guarantees for 70% of the loan or for the full loan, or covering only two years or the whole maturity of the loan), they can have important effects on their effectiveness to address stress in the real economy.

It is beyond our scope to discuss the adequacy of government measures or their effectiveness in detail. However, as we see later in Section IV, the size and the effectiveness of government measures can strongly mitigate the impact of the COVID-19 pandemic on the economy.

#### **IV. From the Impact on the Real Economy to Nonperforming Loans**

In the previous section, we separately analyzed the channels through which the pandemic can impact households and nonfinancial corporations, and we would like ultimately to assess the resilience of the banking system to an increase in NPLs. In this section, we link these two important issues.

We start with a framework for the default of a nonfinancial corporation or a household on its bank loan payments. We do so by looking at the main items in the flow statements. In a second step, we compute the amount of new NPLs caused by the COVID-19 pandemic in the euro area. In that process, we design several scenarios for the evolution of the pandemic during 2021, considering various sizes of government support. We finish with an analysis of corporate insolvencies and how they may affect NPLs in the household sector, as a result of job destruction directly caused by these insolvencies.

### A. Conditions for the Default of Bank Loan Payments by Nonfinancial Corporations and Households

Based on its balance sheet and the inflows and outflows, we consider that a nonfinancial corporation  $i$  would not pay back its loans if:

$$IL^i > S^i \times (1 - \widehat{IP}^s) + TR^i + IF^i - OF^i + SFA^i \quad (4)$$

where  $IL$  refers to the interest paid on loans,  $S$  to the sales,  $\widehat{IP}^s$  to the impact of the pandemic on the sector of activity of the nonfinancial corporation,  $TR$  to transfers from the government,  $IF$  to inflows,  $OF$  to outflows, and  $SFA$  to inflows from the sale of fixed assets.

The interest of the loans is determined by the volume of loans in the liabilities side of the balance sheet and by the interest rate of the loans. If we define the debt ratio as the share of debt over total assets, then Equation (4) can be expressed as:

$$DR^i > \frac{1}{r^i} \times \left( \frac{S^i \times (1 - \widehat{IP}^s)}{TA^i} + \frac{TR^i}{TA^i} + \frac{IF^i - OF^i}{TA^i} + \frac{SFA^i}{TA^i} \right) \quad (5)$$

where, in addition to the variables defined above,  $DR$  refers to the debt ratio,  $TA$  to total assets, and  $r$  to the interest rate of the loans.

Operating further, we can express the same condition as in Equation (5) with the impact of the pandemic on the left side of the inequality:

$$\widehat{IP}^s > \frac{TA^i}{S^i} \times \left( \frac{TR^i}{TA^i} + \frac{S^i + IF^i - OF^i}{TA^i} + \frac{SFA^i}{TA^i} - (DR^i \times r^i) \right) \quad (6)$$

Together with the impact of the pandemic, the main factors driving the recognition of NPLs are the existing indebtedness of the nonfinancial corporation (that is, its debt ratio), the interest rate paid on the stock of loans, the transfers received from the government, and the ability to dispose of fixed assets to generate inflows.

Looking at the government support, the main measures are loan moratoria, loan guarantees, and direct transfers. The first effort implies that there is no interest payment due, so the loan cannot become nonperforming. Loan guarantees ensure that there are additional loans to finance the operations of the nonfinancial corporation, thus increasing its debt ratio and its inflows. Finally, direct transfers are seen in Equation (6) as an increase in the term  $TR^i$ .

Considering that there are  $N$  nonfinancial corporations in a sector, we can identify a number  $I$  of them that would fulfil Equation (6) and then default on their loans. Consequently, at the level of the sector  $s$ , the new arising NPLs would be equal to:

$$NPL^s = \sum_{i=1}^I TL^i \quad (7)$$

where  $NPL^s$  refers to the additional amount of nonperforming loans and  $TL$  to total loans.



Similarly, NPLs arise in the household sector if the following condition is met:

$$DR^j > \frac{W^j \times (1 - \widehat{IP}^H) + TR^j + IF^j - OF^j + SA^j}{TA^j \times r^j} \quad (8)$$

where  $DR^j$  refers to the debt ratio of a household  $j$ ,  $W$  to the wages received by that household,  $\widehat{IP}^H$  to the impact of the pandemic on the household sector,  $TR$  to transfers from the government,  $IF$  to inflows,  $OF$  to outflows,  $SA$  to the inflows derived from the sale of assets on the balance sheet of households (real estate, financial assets, pension and insurance rights, and other assets),  $TA$  to total assets, and  $r$  to the interest rate of household loans.

In Equation (8), we also need to account for the lower consumption of households, which should decrease their outflows. We then introduce the impact of the pandemic on nonfinancial corporations as follows:

$$DR^j > \frac{W^j \times (1 - \widehat{IP}^H) + TR^j + IF^j - (CO^j \times (1 - (\beta \times \widehat{IP}^{NFC}))) - OOF^j + SA^j}{TA^j \times r^j} \quad (9)$$

where, in addition to the variables defined for Equation 8,  $\widehat{IP}^{NFC}$  refers to the impact of the COVID-19 pandemic on the total sector of nonfinancial corporations,  $\beta$  is a coefficient related to the reduction in consumption stemming from the impact of the pandemic on nonfinancial corporations, and  $OOF$  refers to outflows other than consumption.

We rearrange Equation (9) to bring the impact of the pandemic to the left side of the inequality:

$$\widehat{IP}^H > 1 + \frac{IF^j}{W^j} - \frac{CO^j}{W^j} - \frac{OOF^j}{W^j} + \frac{CO^j \times \beta \times \widehat{IP}^{NFC}}{W^j} + \frac{TR^j}{W^j} + \frac{SA^j}{W^j} - \left( Debt^j \times \frac{r^j}{W^j} \right) \quad (10)$$

The equation above takes into account the financial soundness with which households entered the pandemic (seen through their level of debt) as well as the difference between inflows and outflows. Government support measures for households work by sustaining their wages (through temporal compensation schemes) and as transfers (for example, unemployment benefits).

Considering that there are  $N$  households in the economy, we can identify a number  $J$  of them that would fulfil Equation (10). Consequently, new NPLs related to household loans would be equal to:

$$NPL^H = \sum_{j=1}^J TL^j \quad (11)$$

where  $NPL^H$  refers to the amount of NPLs from loans to households and  $TL$  to total loans. At the level of the economy, the total amount of NPLs is the sum of those arising from nonfinancial corporations and those from the household sector:

$$NPL = \sum_{s=1}^S NPL^S + NPL^H \quad (12)$$

## B. Estimating the Impact of the COVID-19 Pandemic on Nonfinancial Corporations in the Euro Area

We compute the impact of the pandemic on euro area nonfinancial corporations using short-term statistics prepared by Eurostat over the period March to December 2020 (Eurostat 2022c).<sup>13</sup> Short-term statistics provide an index of turnover by main NACE codes. We need to slightly adjust the sectoral division of nonfinancial corporations we have used so far (see Table 8 in Appendix C).

The impact of the COVID-19 pandemic over each sector is computed as lost turnover since February 2020, according to the following expression:

$$\widehat{IP}^s = \left( \frac{\sum_{March\ 2020}^{December\ 2020} (Index_t^s - \overline{Index^s})}{\sum_{February\ 2020}^{March\ 2019} Index_t^s} \right) \quad (13)$$

where  $\widehat{IP}^s$  represents the impact of the COVID-19 pandemic on sector  $s$ ,  $Index_t^s$  the value of the index according to the short-term indicators by Eurostat for sector  $s$ , and  $\overline{Index^s}$  the value taken by the index in February 2020.

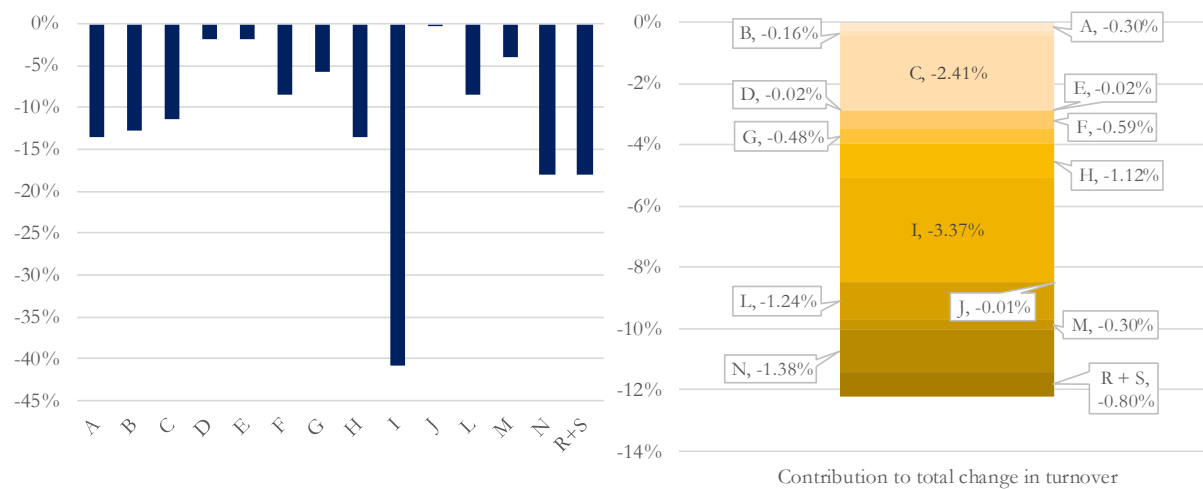
Figure 4 shows that the largest impacts are found in the sectors of accommodation and food service activities, administrative and support service activities, arts, entertainment and recreation, and other services activities.<sup>14</sup> Using the weight of each sector on the total gross value added by nonfinancial corporations, the total impact of the COVID-19 pandemic in the euro area is -12.21%. That result implies that the pandemic, between March and December 2020, led to a decrease of 12.21% in the turnover of euro area nonfinancial corporations, based on the turnover of the previous 12 months (March 2019 to February 2020).

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<sup>13</sup> Sectoral annual accounts are available only for the euro area. Although Eurostat publishes data for the European Union (EU) as a whole as well, we are computing the impact of the pandemic on the euro area to cross-check our results with the sectoral balance sheets in Appendix A.

<sup>14</sup> For a comparison with our impact of the pandemic according to Equation (1), see Appendix C.

**Figure 4: Impact of the COVID-19 Pandemic on the Turnover of Nonfinancial Corporations**



Notes: Data are seasonally and calendar adjusted. The blue bars represent the change in total turnover per sector, computed according to Equation (13). See Appendix C for the mapping of sectors in Eurostat data. Data for sectors H, J, M, and N for October, November, and December 2020 are computed as the average of the observations for Spain, France, Latvia, Luxembourg, Portugal, Slovenia, Slovakia, and Finland, as Eurostat had not published the euro area aggregate in April 2021. The chart on the right represents the contribution of each sector to the overall impact, using weights of gross value added. A stands for agriculture, forestry, and fishing; B for mining and quarrying; C for manufacturing; D for electricity, gas, steam, and air conditioning supply; E for water supply, sewerage, and waste management and remediation activities; F for construction; G for wholesale and retail trade and repair of motor vehicles and motorcycles; H for transporting and storage; I for accommodation and food service activities; J for information and communication services; L for real estate activities; M for professional, scientific, and technical activities; N for administrative and support service activities; R for arts, entertainment, and recreation; and S for other services activities.

Source: Eurostat 2022c; author's analysis.

Up to this point, we have implicitly assumed that turnover returned to the level of February 2020 in January 2021, an assumption that unfortunately did not hold. The assessment above offers a partial view of the impact, and it is necessary to complement it by taking into account the evolution of the pandemic from January 2021.

To that purpose, we compute first the stringency index by the University of Oxford, which measures the severity of the health-related measures taken by governments to contain the COVID-19 pandemic (Hale et al. 2020). We then calculate the correlation between the median stringency index for euro area countries (taking the average values for each month) and the turnover of the different sectors of activity, as reported by Eurostat. These correlations are negative for all sectors of activity and, in some of them until September 2020, close to  $-1$  (Figure 5). The decrease of correlations when we consider data up to December 2020 may suggest that nonfinancial corporations were able to adjust to the pandemic and were, thus, not so much affected as in the first half of 2020.

**Figure 5: Correlations between the Stringency Index and the Short-Term Indicators by Eurostat**

Sector	Correlation	
	Up to Sept 2020	Up to Dec 2020
Agriculture, forestry, and fishing	-0.96	-0.74
Mining and quarrying	-0.88	-0.64
Manufacturing	-0.89	-0.60
Electricity, gas, steam, and air conditioning supply	-0.65	-0.39
Water supply, sewerage, and waste management and remediation activities	-0.65	-0.39
Construction	-0.73	-0.58
Wholesale and retail trade and repair of motor vehicles and motorcycles	-0.78	-0.60
Transporting and storage	-0.96	-0.74
Accommodation and food service activities	-0.94	-0.94
Information and communication services	-0.43	-0.48
Real estate activities	-0.73	-0.58
Professional, scientific, and technical activities	-0.87	-0.43
Administrative and support service activities	-0.93	-0.86
Arts, entertainment, and recreation	-0.93	-0.86
Other services activities	-0.93	-0.86

Notes: Correlations between the values of the stringency index (median of monthly data across euro area countries) and of the short-term indicators by Eurostat, considering two periods of time: from January 2020 to September 2020, and from January 2020 to December 2020. Some sectors are missing in the Eurostat database and have been mapped as shown in Appendix C.

Sources: Eurostat 2022c; Hale et al. 2020; author's elaboration.

We estimate a simple linear regression where the turnover index is the dependent variable, and the stringency index is the independent variable.

$$Index_t^s = \alpha^s + (\beta^s \times Stringency_t) + \varepsilon_t^s \quad (14)$$

where  $Index_t^s$  represents the turnover index after December 2020,  $\alpha^s$  the intercept,  $\beta^s$  is the coefficient associated with the stringency index,  $Stringency_t$  the value taken by the stringency

index, and  $\varepsilon_t^s$  the error term. The resulting equation for each sector allows us to forecast the evolution of the turnover index over 2021, based on the values taken by the stringency index.

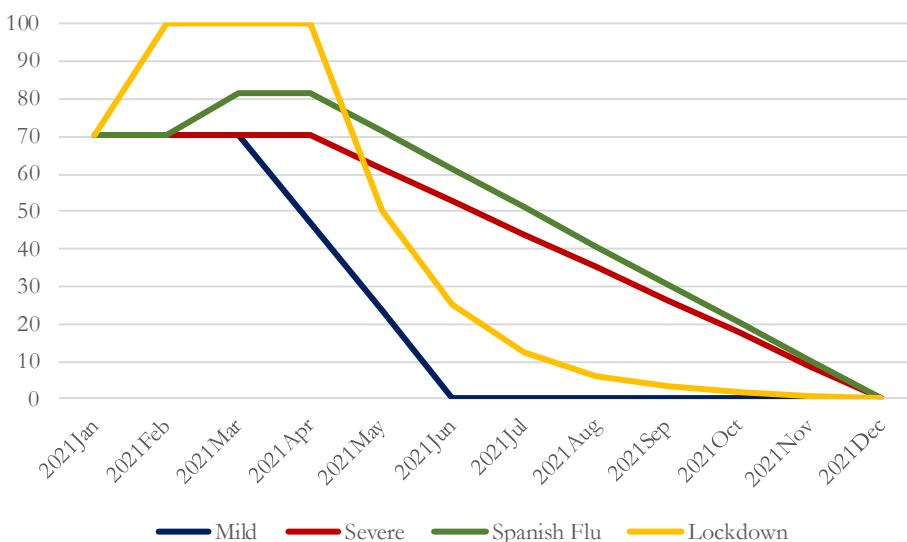
We define the following scenarios for the evolution of the pandemic in 2021 (Figure 6):

*Mild.* The stringency index remains in the values of December 2020 during January, February, and March, then decreases linearly until reaching the value zero in June 2021. We can use this scenario as a floor for our estimations.

*Severe.* The stringency index remains in the values of December 2020 during January, February, March, and April and then decreases linearly until reaching the value zero in December 2021. The slower reduction in the stringency index under this scenario can be seen also in the context of a slower-than-expected vaccination process or the appearance of new mutations of the virus.

*Spanish flu.* Like the situation in 1918–1919, the pandemic hits in three waves (CDC 2018), the third one occurring between March and April 2021, with the stringency index taking the same value as in April 2020. The COVID-19 pandemic follows closely that of the Spanish flu and ends in December 2021.

*Lockdown.* There is a two-month lockdown in February and March 2021, with the stringency index at its maximum value, then the pandemic abates quickly through December 2021. This scenario can be compared with the others to see the impact of strict lockdowns on economic activities over the long term.

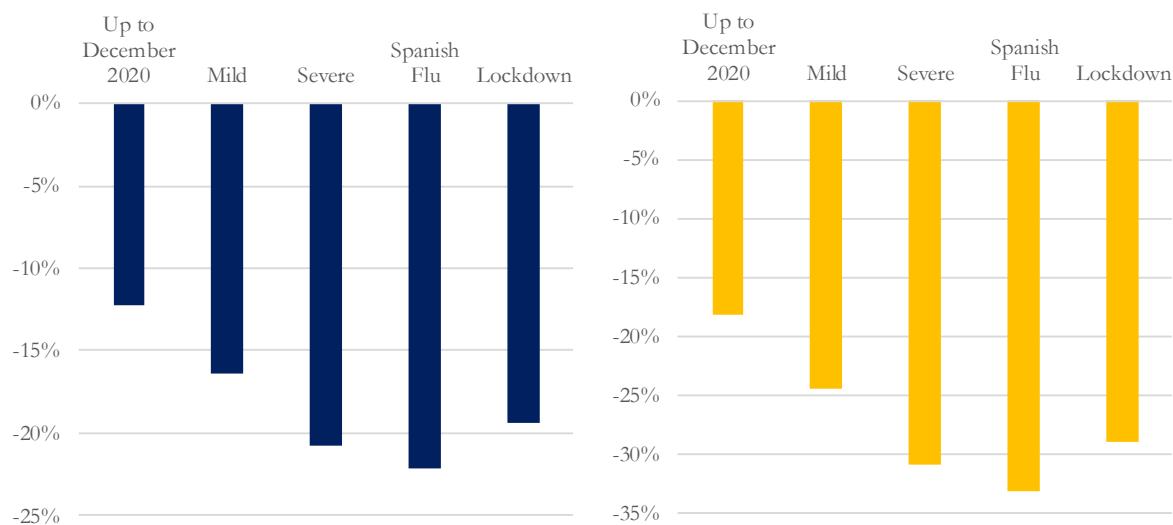
**Figure 6: Stringency Index over 2021 in the Four Scenarios**

Notes: Each line represents the evolution of the stringency index over 2021, as per the assumptions made in the description of each of the four scenarios.

Source: Hale et al. 2020; author's analysis.

We then compute Equation (13), extending the denominator until the period when the stringency index is back to zero (June 2021 and December 2021). As observed in the left panel of Figure 7, the decrease in total sales is slightly above 16% for the mild scenario (4 percentage points more than at the end of December 2020), almost 21% for the severe scenario (doubling the loss until December 2020), and slightly above 22% for the Spanish flu scenario. The lockdown scenario leads to a decline in sales of circa 19.5%, less than the relatively similar severe and Spanish flu scenarios. That outcome could be seen as pointing out to the benefits of strong responses to the pandemic, in opposition to a prolonged pandemic where forceful measures are not taken. When the impact is defined in terms of the accumulated net worth of nonfinancial corporations (using the data in Appendix A), the three scenarios extending the pandemic until December 2021 consume about 30% of accumulated net worth for the aggregate of nonfinancial corporations (right panel of Figure 7).

**Figure 7: Decrease in Turnover of Nonfinancial Corporations in the Four Scenarios for the COVID-19 Pandemic over 2021**



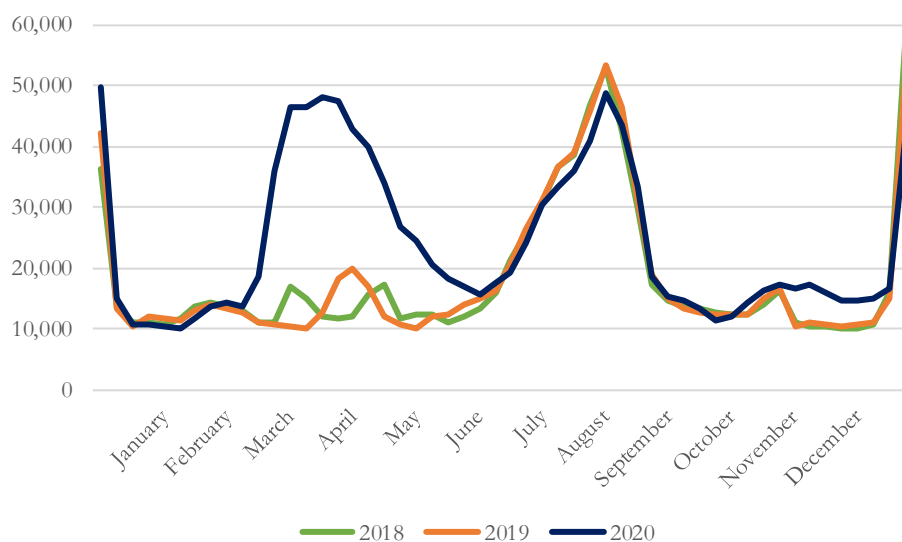
Notes: The left panel shows the change in turnover under the four scenarios (and up to December 2020) as a percentage of the turnover between March 2019 and February 2020. The yellow bars in the right panel show the size of the lost turnover as a share of the accumulated net worth on the balance sheet of nonfinancial corporations at the end of 2019.

Source: Author's analysis.

### C. Estimating the Impact of the COVID-19 Pandemic on Households in the Euro Area

To estimate the impact of the pandemic on households, we use data from Eurostat on weekly absences from work in the European Union (EU; excluding the United Kingdom).<sup>15</sup> Figure 8 shows the evolution of the weekly absences from work during 2018, 2019, and 2020. In 2020, many more absences from work were reported in March, April, and May, with a second smaller peak toward the end of the year.

<sup>15</sup> See Eurostat (2022b). Eurostat data do not show an aggregate for the euro area, so we use the EU as a proxy.

**Figure 8: Weekly Absences from Work in the EU**

Notes: Each line represents the weekly absences from work over the years 2018, 2019, and 2020, as reported by Eurostat for the EU 27. The last observation is week 52, whereas 2020 had 53 weeks. Data for week 53 has not been taken into account in our calculations.

Sources: Eurostat 2022b; author's elaboration.

On that basis, we define the impact of the COVID-19 pandemic on households as absences from work in 2020 divided by the average of those reported in the two previous years (2018 and 2019):

$$\widehat{IP}^H = - \left( \frac{\sum_{W01}^{W52} Absences^{2020} - \frac{(\sum_{W01}^{W52} Absences^{2019} + \sum_{W01}^{W52} Absences^{2018})}{2}}{\frac{(\sum_{W01}^{W52} Absences^{2019} + \sum_{W01}^{W52} Absences^{2018})}{2}} \right) \quad (15)$$

where  $\widehat{IP}^H$  refers to the impact of the COVID-19 pandemic on households,  $W01$  to the first week of the year,  $W52$  to the last week of the year, and  $Absences^{2018}$ ,  $Absences^{2019}$ , and  $Absences^{2020}$  to the weekly absences from work for years 2018, 2019, and 2020, respectively.

Absences from work were 31.68% higher in 2020, and we can attribute this increase to the COVID-19 pandemic. That is the direct impact of the pandemic on households, without taking into account important mitigants present in Equation (10): the extent of government support (including unemployment benefits) and the reduction in consumption derived from lower economic activity.

#### D. Estimating the Increase of Nonperforming Loans from Nonfinancial Corporations in the Euro Area

In this section, we provide an answer to the question of how many NPLs can be expected to arise from the economic shock caused by the COVID-19 pandemic, once the positive effects of



the support measures taken by governments are taken into account. We base our estimations on Equation (6) and Equation (10) for nonfinancial corporations and households, respectively. Given our focus on the euro area, we consider two important additional points on nonfinancial corporations: (1) bank lending is the main source of finance for nonfinancial corporations, particularly if compared with the US (Pagano et al. 2014), so we do not consider other market-based sources of funding; and (2) small and medium-size enterprises play a fundamental role in the European economies, in terms of production, employment, investment, and value added (European Commission 2019).

Starting with nonfinancial corporations, Figure 9 summarizes our main assumptions. Because the results for the severe, Spanish flu, and lockdown scenarios are quite similar, we consider only the severe scenario. For interest rates, we assume a value of 2%, based on the monetary financial institutions interest rates (MIR) database of the European Central Bank (ECB 2021b). The ratio between total assets and sales is calculated from the balance sheet of the euro area economy, as in Appendix A.

For the debt ratio and the total inflows and outflows divided by total assets, we use data from the Bank for the Accounts of Companies Harmonized (BACH) database of the European Committee of Central Balance Sheet Data Offices (ECCBSO).<sup>16</sup> We use data from more than 2.2 million nonfinancial corporations located in Austria, Belgium, Germany, Spain, Italy, Luxembourg, Portugal, and Slovakia with a reference date of the end of 2018 (data for 2019 is still being updated). These are the countries with the highest coverage in the BACH database. The first and third quartiles and the median of each ratio are disclosed by country. We calculate the median across countries to get to an approximation of the value for the euro area.

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<sup>16</sup> Bank for the Accounts of Companies Harmonized (BACH) is a database of aggregated and harmonized accounting data of nonfinancial incorporated enterprises of 12 European countries, based on national accounting standards (individual annual accounts) and maintained by the European Committee of Central Balance Sheet Data Offices. For further information, see Bach Working Group (2015).

**Figure 9: Values Attributed to Main Variables in the Estimation of NPLs Arising from the COVID-19 Pandemic in Relation to Loans to Nonfinancial Corporations**

Variable	Value	Comments
$\widehat{IP}^s$	Depends on sector	As estimated in Section IV.B
$\frac{S^i}{TA^i}$	0.1096	Calculated from the amounts reported in Appendix A
$\frac{TR^i}{TA^i}$	From 0 to 0.15	Seen as the most plausible amounts. Values greater than 10% of total assets imply transfers from the government of more than EUR 6 trillion
$\frac{S^i + IF^i - OF^i}{TA^i}$	Depends on sector	Ratio of net operating profit to total assets, from the BACH database, estimated to follow a normal distribution
$\frac{SFA^i}{TA^i}$	From 0 to 0.05	
$DR^i$	Depends on sector	Sum of the ratios of current interest-bearing borrowings to total assets and noncurrent interest-bearing borrowings to total assets, from the BACH database, estimated to follow a normal distribution. We exclude amounts due to suppliers (typically the most relevant short-term debt of nonfinancial corporations). Through supplier relationships, nonfinancial corporations are importantly interconnected across jurisdictions and across sectors, the car industry being the clearest example (see, for example, Baldwin and Lopez-Gonzalez 2015).
$r^i$	0.02	Based on the Monetary Financial Institutions Interest Rate (MIR) Statistics of the ECB, the agreed interest rates for loans to nonfinancial corporations in the euro area, at all maturities, was 1.87% in December 2019. We round it up to 2%

Source: Bach Working Group 2015; ECB 2021b; and author's analysis.

We assume that the ratio of net operating profit to total assets follows a normal distribution across nonfinancial corporations in a given sector, with the median as the mean, and the variance calculated from the interquartile range<sup>17</sup>:

<sup>17</sup> In a standard normal distribution (with mean equal to 0 and standard deviation equal to 1), the first and third quartiles are located at -0.67448 and +0.67448 respectively, leading to an interquartile range of 1.34896 (rounded to 1.35).

$$\frac{NOP}{TA} \approx N(Q2, \left(\frac{Q3-Q1}{1.35}\right)^2) \quad (16)$$

where  $NOP$  refers to net operating profit,  $TA$  to total assets, and  $Q1$ ,  $Q2$ , and  $Q3$  to the first quartile, the median, and the third quartile, respectively.

We make the same assumption for the ratio of current and noncurrent debt to total assets:

$$\frac{CD+NCD}{TA} \approx N(Q2, \left(\frac{Q3-Q1}{1.35}\right)^2) \quad (17)$$

where  $CD$  refers to current debt and  $NCD$  to noncurrent debt. In this case, we truncate the range of values to be in the interval  $[0, 1]$ , not allowing for debt to be larger than the total size of the balance sheet and not considering negative values of the ratio. These cases appear only at the left and right tails of the distribution, with low associated probabilities.

Next, we assume that both normal distributions are related: Those firms showing lower values of the net operating profit to total assets are also having higher values of the debt ratio. Similarly, nonfinancial corporations with higher profitability also have lower associated values of the debt ratio.

For each sector of activity, we attribute values to the transfers from the government and to the sale of fixed assets between 0 and 0.15, and between 0 and 0.05, respectively.<sup>18</sup> There are thus 96 different combinations, and for each one, we calculate Equation (6) for 600 values of the ratio of net operating profit to total assets and the related current and noncurrent debt to total assets. These 600 values range from 3X to -3X the standard deviation, at intervals of 0.01.

The increase in the rate of NPLs as a result of the COVID-19 pandemic is defined as the difference of the probability associated with the last value of the ratio of net operating profit to total assets for which Equation (6) holds and the same probability assuming that the impact of the pandemic is zero:

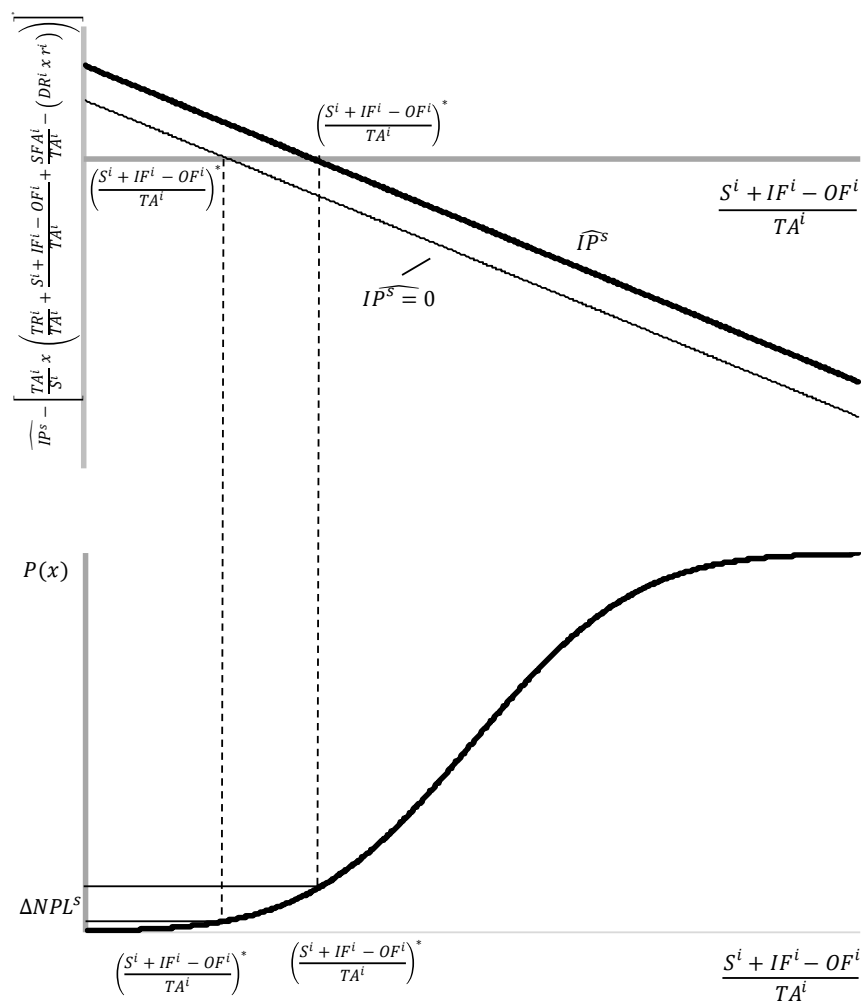
$$\Delta NPL^s = Prob \left[ \left( \frac{S^i + IF^i - OF^i}{TA^i} \right)^* \mid \widehat{IP}^s \right] - Prob \left[ \left( \frac{S^i + IF^i - OF^i}{TA^i} \right)^* \mid 0 \right] \quad (18)$$

where  $\Delta NPL^s$  refers to the increase in the rate of NPLs in sector  $s$ ,  $\left( \frac{S^i + IF^i - OF^i}{TA^i} \right)^*$  to the first value of  $\frac{S^i + IF^i - OF^i}{TA^i}$  for which Equation (6) holds, and  $\widehat{IP}^s$  to the impact of the pandemic on sector  $s$  (Figure 10).

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<sup>18</sup> Appendix A shows that nonfinancial corporations in the euro area received transfers amounting to about 1% of their total assets in 2019. Given their small size and to ease our calculations, such transfers are not considered in our estimation.

**Figure 10: Increase in the Rate of NPLs to Euro Area Nonfinancial Corporations from the COVID-19 Pandemic**



Notes: The diagonal line at the top of the chart shows the relation between the ratio of net operating profit to total assets and the result of Equation (6), used to derive when a nonfinancial corporation would default on the loans, with and without pandemic. The intersection of the two lines with the x-axis is then translated into the cumulative distribution function of a normal distribution for the ratio of net operating profit to total assets. The difference between the two associated cumulative probabilities is estimated to be the increase in NPLs generated by the COVID-19 pandemic.

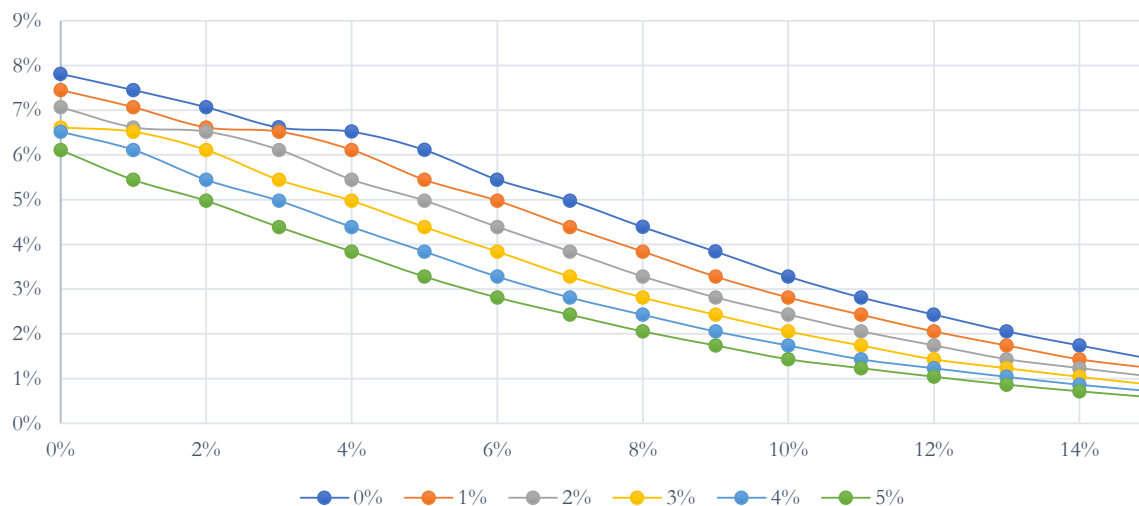
Source: Author's analysis.

Once the increase in the rate of NPLs is computed by sector, data from the EBA Risk Dashboard (EBA 2020b) on loans to nonfinancial corporations according to NACE codes allows us to obtain the weight of each sector on lending to nonfinancial corporations in the euro area. Using these weights, we can obtain the increase in the rate of NPLs related to loans to nonfinancial corporations in the euro area.

Figure 11 depicts the rate of nonperforming loans arising under the different combinations of transfers from the government and sales of fixed assets. A situation where no government

support is available, and no fixed assets are sold leads to additional NPLs of 7.81% of loans to nonfinancial corporations (EUR 881 billion, according to data from Appendix A).

**Figure 11: Increase in the Rate of NPLs to Euro Area Nonfinancial Corporations from the COVID-19 Pandemic**



Notes: The y-axis shows the increase, as a percentage of total loans, in the rate of NPLs that would be triggered by the COVID-19 pandemic under different combinations of transfers from the government (x-axis) and disposal of assets (see legend). Data refers to the euro area. Sector J (information and communication) is excluded as it shows a small positive impact of the pandemic, which would result in a reduction of NPLs.

Source: Author's analysis.

Government support measures are effective in reducing the amount of NPLs caused by the pandemic. When transfers from the government represent 10% of total assets of nonfinancial corporations and in the absence of any action on the side of nonfinancial corporations, the additional NPLs are reduced to 3.28% (EUR 370 billion, according to data from Appendix A). However, it is necessary to put these amounts in perspective: transfers from the government sector of 10% of the total balance sheet of nonfinancial corporations in the euro area total more than EUR 4.3 trillion.<sup>19</sup> As signaled in Section III.D, loan moratoria do not imply a transfer of resources from the government sector to nonfinancial corporations but indicate a suspension of interest payments. In this case, thus,  $IL^i$  is equal to zero. Given that our analysis also covers 2021 and as most loan moratoria in the euro area were set to expire throughout 2021 (affecting mostly households), we do not take loan moratoria into account in these estimates. In the case of loan guarantees, they could indirectly do so, as the transfer occurs with the intermediation of the banking sector. A more realistic scenario, based on ESRB (2021a) findings and considering the transfers made during 2019 (about 1% of total assets, according to Appendix A), could then consider

<sup>19</sup> According to Appendix A, the total balance sheet of euro area nonfinancial corporations amounted to EUR 43.7 trillion at the end of 2019.

government support on the order of 2% of the size of the balance sheet, leading to an increase in NPLs of 7.07% (EUR 797 billion, according to data from Appendix A).<sup>20</sup>

Figure 11 can be interpreted as showing an almost unavoidably large increase in NPLs as a result of the COVID-19 pandemic. To bring that increase close to zero, the effort of the government sector should be enormous, with transfers above EUR 5 trillion. The total size of the balance sheet of the government sector in the euro area was EUR 11.5 trillion at the end of 2019, as shown by Appendix A.

Another alternative for nonfinancial corporations is to sell some of their assets, to generate additional inflows and compensate the drop of sales caused by the pandemic. This strategy entails a destruction of capital and, when sales occur simultaneously, can lead to fire sales and lower proceeds from these operations. Besides, the sales should be massive to have a real impact on the additional NPLs.

As outlined in Section III.D, one of the key conditions for government support to mitigate the impact of the pandemic refers to its effectiveness. One way of addressing government programs' effectiveness in practice is by providing more support to the most impacted sectors.

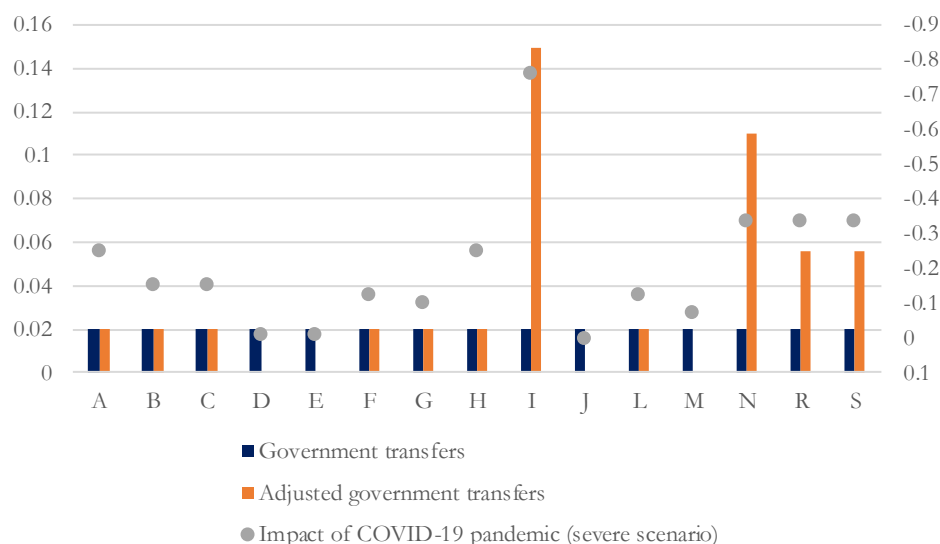
Indeed, our previous calculations implicitly assume a lineal distribution of government transfers across sectors regardless of how much they are impacted by the pandemic. But they are differently impacted: some sectors, such as accommodation and food service activities, are heavily impacted while others, such as information and communication services, do not feel a large impact from the COVID-19 pandemic.

In Section IV.B, we identified sectors I (accommodation and food service activities), N (administrative and support service activities), R (Arts, entertainment, and recreation), and S (other services activities) as those mostly affected by the pandemic, while sectors D (electricity, gas, steam, and air conditioning supply), E (water supply, sewerage, and waste management and remediation activities), J (information and communication services) and M (professional, scientific, and technical activities) were almost not affected. As an illustration of what can be achieved with a targeted used of government transfers, we can assume that transfers of the government are fixed at 2% of the total balance sheet of nonfinancial corporations (EUR 874 billion) and that the transfers are initially allocated to sectors with the lowest impact are distributed first to sector I (accommodation and food service activities) until it reaches 15% of the total balance sheet, and then to sectors N (administrative and support service activities), R (arts, entertainment, and recreation), and S (other services activities), as shown by Figure 12. So, government support effectively goes to the most affected sectors.

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<sup>20</sup> If we consider also the EUR 1.85 trillion of the European Central Bank's Pandemic Emergency Purchase Programme (PEPP), the total size of government support exceeds 6% of total assets of nonfinancial corporations. We do not include the PEPP in our calculations as it is an indirect source of support.

**Figure 12: Impact of the COVID-19 Pandemic and Examples of Targeted Government Transfers to Most Affected Sectors**

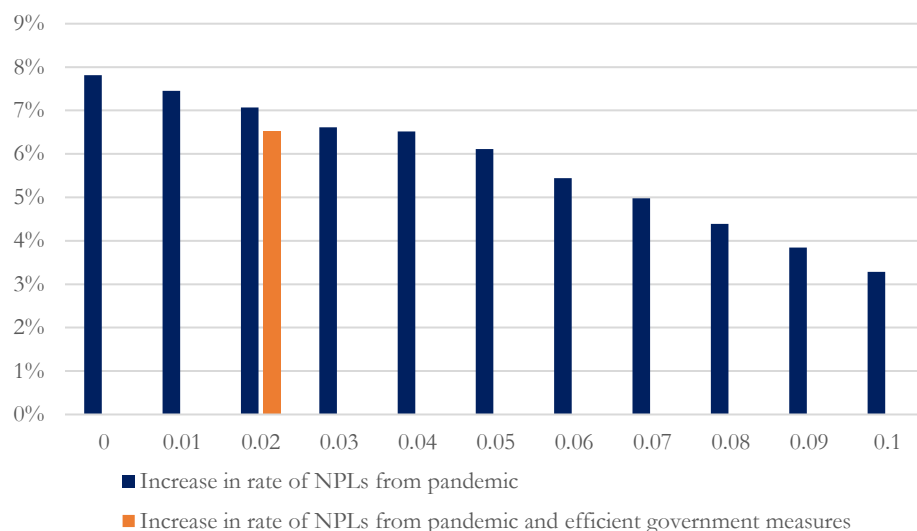


Notes: The blue bars show government transfers of 2% of total assets for all sectors while the orange bars show an example of targeted government transfers to the most affected sectors, according to the severe scenario defined in Section IV.B. The impact of the pandemic under this scenario is shown by the grey dots, with reference to the right axis, with inverted values. A stands for agriculture, forestry, and fishing; B for mining and quarrying; C for manufacturing; D for electricity, gas, steam, and air conditioning supply; E for water supply, sewerage, and waste management and remediation activities; F for construction; G for wholesale and retail trade and repair of motor vehicles and motorcycles; H for transporting and storage; I for accommodation and food service activities; J for information and communication services; L for real estate activities; M for professional, scientific, and technical activities; N for administrative and support service activities; R for arts, entertainment, and recreation; and S for other services activities.

Source: Author's analysis.

As shown by Figure 13, doing so brings the additional rate of NPLs to the same level as that associated with transfers from the government equal to 4% of the total balance sheet of nonfinancial corporations. The difference implies having additional NPLs for EUR 797 billion or for EUR 736 billion.

**Figure 13: Increase in the Rate of NPLs to Euro Area Nonfinancial Corporations from the COVID-19 Pandemic**



Notes: The blue bars show the increase, in percentage points, in the rate of NPLs that would be triggered by the COVID-19 pandemic under different combinations of transfers from the government and assuming no disposal of assets. The orange bar shows the increase in the rate of NPLs in case government transfers are targeted to the sectors most affected by the pandemic. Data refers to the euro area. Sector J (information and communication services) is excluded as it shows a positive impact from the pandemic, which would result in a reduction of NPLs.

Source: Author's analysis.

### E. Estimating the Increase of Nonperforming Loans from Households in the Euro Area

To compute the expected increase in NPLs from households, we use data from the 2017 wave of the ECB Household Finance and Consumption Survey (Household Finance and Consumption Network 2020), which covers the euro area and divides households according to the percentiles 20, 40, 60, 80, and 90 of their income and net worth. To keep all percentiles of the same size, we exclude the 90 percentile and assume that households above it are equal to households between the 80 and 90 percentiles. The reference date for this data is 2017, but these variables are not subject to sudden and large movements in the short term.

While not being very granular, the ECB Household Finance and Consumption Survey allows a direct mapping to the variables in Equation (10), as shown in Figure 14. We consider the distribution of households according to their net wealth.



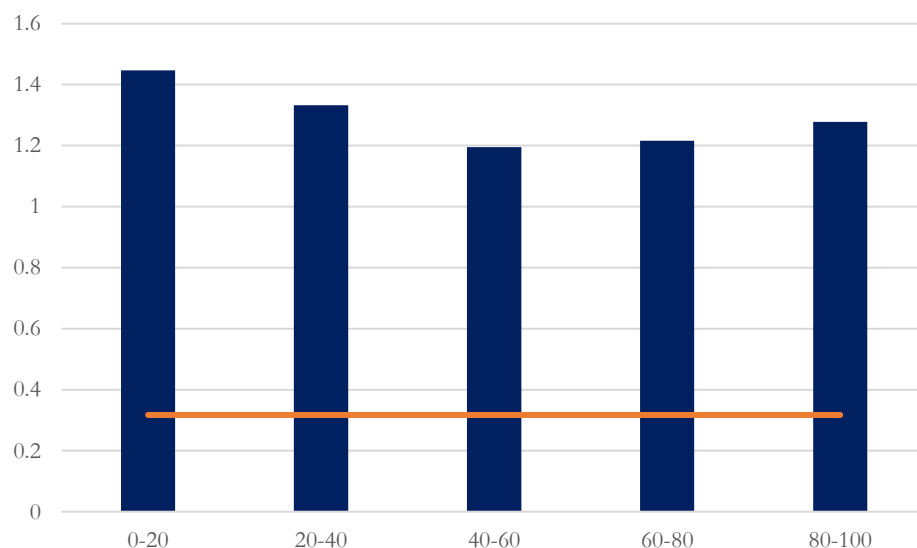
**Figure 14: Values Attributed to Main Variables in the Estimation of NPLs Arising from the COVID-19 Pandemic in Relation to Loans to Households**

Variable	Value	Comments
$\widehat{IP}^H$	0.3168	As estimated in Section IV.C
$IF^j$	Varies across percentiles	Calculated as the difference between median gross household income, as reported in Table 10 of Household Finance and Consumption Network (2020), and wages, calculated as above
$W^j$	Varies across percentiles	From Appendix A, we compute the share of wages over total inflows and apply that share to the median gross household income, as reported in Table 10 of Household Finance and Consumption Network (2020)
$CO^j$	Varies across percentiles	Median expenditures on food and on utilities, Table 11 of Household Finance and Consumption Network (2020)
$OOF^j$	Varies across percentiles	Comprising taxes, as reported in Appendix A, and attributed linearly across our five group of households
$\beta$	0.5	To account for intermediate consumption and consumption by the public sector
$\widehat{IP}^{NFC}$	0.2074	As estimated in Section IV.B for the severe scenario
$TR^j$	Varies across percentiles	Total amount taken from Appendix A and distributed exponentially starting with households with lowest net wealth
$SA^j$	—	At this stage, not considered
$Debt^j$	Varies across percentiles	Conditional mean of total debt, Table 7 of Household Finance and Consumption Network (2020)
$r^j$	0.025	Based on the ECB MIR database (0.0255 as of end 2019)

Sources: ECB 2021b; Household Finance and Consumption Network 2020; author's analysis.

Considering that no additional transfers from governments are made and that households are not in need of selling some assets to maintain their financial position, the direct impact of the pandemic should not lead households to massively default on their loans (Figure 15). Across different groups of households depending on their net wealth, they have a wide buffer to absorb the related losses. An important factor to take into account are the social benefits in place in many European countries (for example, unemployment benefits), which partially shield household income from adverse shocks and mostly benefit households with lower net wealth.

**Figure 15: Impact of COVID-19 Pandemic on Households According to Their Net Wealth**



Notes: The orange line represents the impact of the COVID-19 pandemic on euro area households, as calculated in Section IV.C. The blue bars represent the values taken by the right-side of Equation (10). If blue bars were below the orange line, households could be seen at high risk of nonpayment of their loans. Households are sorted into five groups, depending on their levels of net wealth.

Source: Author's analysis.

While the direct impact of the COVID-19 pandemic and the potential wave of NPLs it generates can be expected to arise in the sector of nonfinancial corporations, households should not witness a widespread increase in NPLs. With the granularity provided by the ECB Household Finance and Consumption Survey, we do not find evidence suggesting a massive deterioration in the financial soundness of households across the euro area.

Nonetheless, three important points are worth noting:

The fact that the aggregated sector seems resilient to the COVID-19 pandemic does not exclude the possibility that the most vulnerable households can experience severe stress. According to Eurostat (2022d), there are approximately 195 million households in the EU, so 5% of them suffering severe financial stress would mean that almost 10 million households are under severe stress.

Government support comes as a cost to governments, which are going to see their indebtedness increase substantially. The impact of the COVID-19 pandemic on government debt sustainability is not under the scope of this paper, but it may be particularly large if economic recovery is not strong enough to allow for a discontinuation of the support measures in the medium term.

Second-round effects derived from additional stress in nonfinancial corporations over 2021 are not considered. For example, if reduced sales of nonfinancial corporations as a

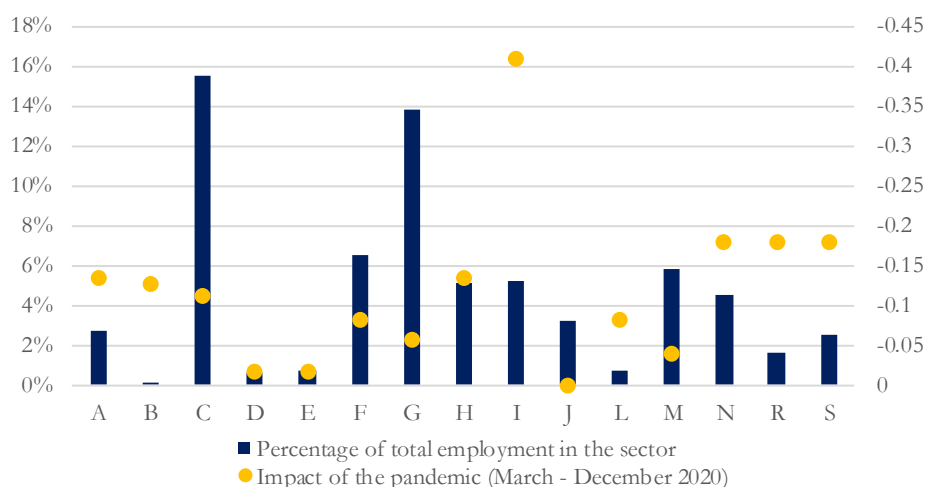
result of the COVID-19 pandemic start having widespread consequences for their solvency, households working in the most affected nonfinancial corporations could lose their jobs and their main source of income.

## **F. Second-Round Effects from Corporate Insolvencies**

We concluded in the previous section that the COVID-19 pandemic should not directly create a wave of NPLs in the household sector. However, households can be affected by massive corporate insolvencies triggered by the pandemic, as many of them would lose their main source of income within a short time. In this section, we look at the potential for massive corporate insolvencies and how that may affect NPLs in the household sector. Our main assumption in this section is that the additional nonfinancial corporations with negative equity file for insolvency and then fire their employees, who would lose their main source of income and, in turn, could default on their loan payments.

Using data from Eurostat on the number of employees in the euro area per NACE sector (Eurostat 2022a), we see that the sectors of nonfinancial corporations with the highest number of employees (manufacturing, and wholesale and retail trade) would in principle not be much affected by the COVID-19 pandemic (Figure 16). The most affected sector (accommodation and food service activities) employs a relatively small proportion of workers in the EU, slightly above 5% of the total.

**Figure 16: Total Employment per Sector (left side) and Impact of the COVID-19 Pandemic (right side)**



Notes: The blue bars represent the percentage of employees in the euro area in each sector of nonfinancial corporations while the orange dots represent the impact of the pandemic (with values in reversed order) between March and December 2020, computed in Section IV.B. A stands for agriculture, forestry, and fishing; B for mining and quarrying; C for manufacturing; D for electricity, gas, steam, and air conditioning supply; E for water supply, sewerage, and waste management and remediation activities; F for construction; G for wholesale and retail trade and repair of motor vehicles and motorcycles; H for transporting and storage; I for accommodation and food service activities; J for information and communication services; L for real estate activities; M for professional, scientific, and technical activities; N for administrative and support service activities; R for arts, entertainment, and recreation; and S for other services activities.

Sources: Eurostat 2022a; author's analysis.

A nonfinancial corporation is under severe risk of insolvency when its accumulated net worth and the shares and other equity are negative (in other words, when the value of all the liabilities exceed the value of its assets). In the context of the shock the COVID-19 pandemic caused, that would imply that the inflows and outflows of 2020 should exceed their accumulated net worth and equity at the end of 2019:

$$NW^i + EQ^i < \left( S^i \times (1 - \widehat{IP}^s) \right) + TR^i + IF^i - OF^i - IL^i + SFA^i \quad (19)$$

where  $NW$  refers to accumulated net worth,  $EQ$  to shares and other equity,  $S$  to sales,  $\widehat{IP}^s$  to the impact of the pandemic on the sector of activity  $s$ ,  $TR$  to transfers from the government,  $IF$  to inflows,  $OF$  to outflows,  $IL$  to the interest paid on loans, and  $SFA$  to inflows from the sale of fixed assets.

We regroup the terms in Equation (19) and get an expression as follows:

$$\frac{NW^i + EQ^i}{TA^i} < \left( \frac{S^i}{TA^i} \times (-\widehat{IP}^s) \right) + \frac{TR^i}{TA^i} + \frac{S^i + IF^i - OF^i - IL^i}{TA^i} + \frac{SFA^i}{TA^i} \quad (20)$$

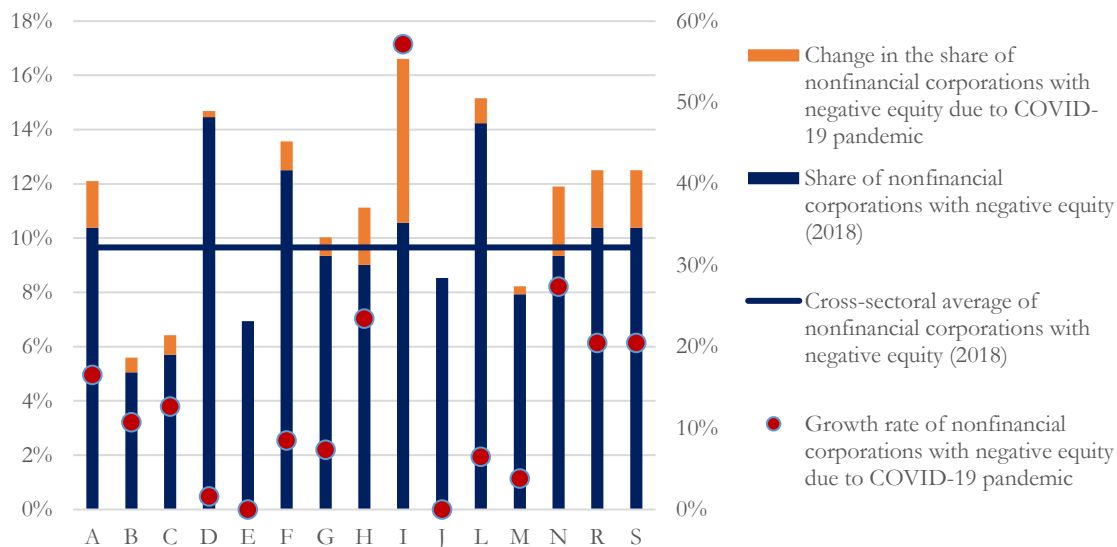
where, in addition to the variables defined in Equation (19),  $TA$  refers to total assets. We can interpret  $S^i + IF^i - OF^i - IL^i$  as the profit of the period for the nonfinancial corporation  $i$ .

Looking at the BACH database of the ECCBSO, we consider that the term  $\frac{NW^i+EQ^i}{TA^i}$  is equivalent to the inverse of the assets-to-equity ratio. We assume that the inverse of the assets-to-equity ratio follows a normal distribution, computing the variance from the interquartile range.

$$\frac{NW+EQ}{TA} \approx N(Q2, \left(\frac{Q3-Q1}{1.35}\right)^2) \quad (21)$$

From here, we compute the number of nonfinancial corporations in each sector operating with negative equity before the start of the pandemic. These are the blue bars in Figure 17, with values fluctuating between 5% (mining and quarrying) and 15% (electricity, gas, steam, and air conditioning supply; and real estate activities). The blue bars in Figure 17 can be seen as the proportion of “zombie” corporations in each sector prior to the pandemic.

If we apply the shock caused by the pandemic  $\left(\frac{S^i}{TA^i} x (-\widehat{IP}^s)\right)$ , with the first term equal to 0.1096 and the second term taken from our estimation in Section IV.B) and absent transfers from the government and sales of assets, the number of nonfinancial corporations operating with negative equity increases, as shown by the orange bars in Figure 17. Overall, the average increase is about 1.4% (affecting about 1% of the total employees in the euro area), albeit with large heterogeneity across sectors. The larger increase is found in the accommodation and food service activities sector, which has been subject to the largest shock from the COVID-19 pandemic and where nonfinancial corporations with negative equity increase from 10.56% to 16.60%. Several sectors (transporting and storage; administrative and support service activities; arts, entertainment, and recreation; and other services activities) see growth of the share of nonfinancial corporations with negative equity above 20% as well. At the other extreme, the water supply, sewerage, and waste management and remediation activities sector and information and communication services do not see any increase in the proportion of nonfinancial corporations with negative equity as a result of the pandemic, while others have minor increases.

**Figure 17: Share of Nonfinancial Corporations with Negative Equity**

Notes: The blue bars represent the share of nonfinancial corporations with negative equity as of 2018, according to Equation (21) and using data from the BACH database. The orange bars represent the change in that number derived from the impact of the COVID-19 pandemic. The blue dots, in the right axis scale, represent the growth in the number of nonfinancial corporations with negative equity before and after the pandemic. A stands for agriculture, forestry, and fishing; B for mining and quarrying; C for manufacturing; D for electricity, gas, steam, and air conditioning supply; E for water supply, sewerage, and waste management and remediation activities; F for construction; G for wholesale and retail trade and repair of motor vehicles and motorcycles; H for transporting and storage; I for accommodation and food service activities; J for information and communication services; L for real estate activities; M for professional, scientific, and technical activities; N for administrative and support service activities; R for arts, entertainment, and recreation; and S for other services activities.

Sources: BACH Working Group 2015; author's analysis.

So far, we have not considered any form of government support to nonfinancial corporations. As in Section IV.D, we make different assumptions about the size of government support in terms of total assets of nonfinancial corporations. Besides, we have seen that about 10% of nonfinancial corporations entered the COVID-19 pandemic with negative equity, signaling a worrying solvency position. We can make several assumptions about the share of these that would become insolvent as a result of the COVID-19 pandemic.

We can express the amount of NPLs to arise from the second-round effects of corporate insolvencies as follows:

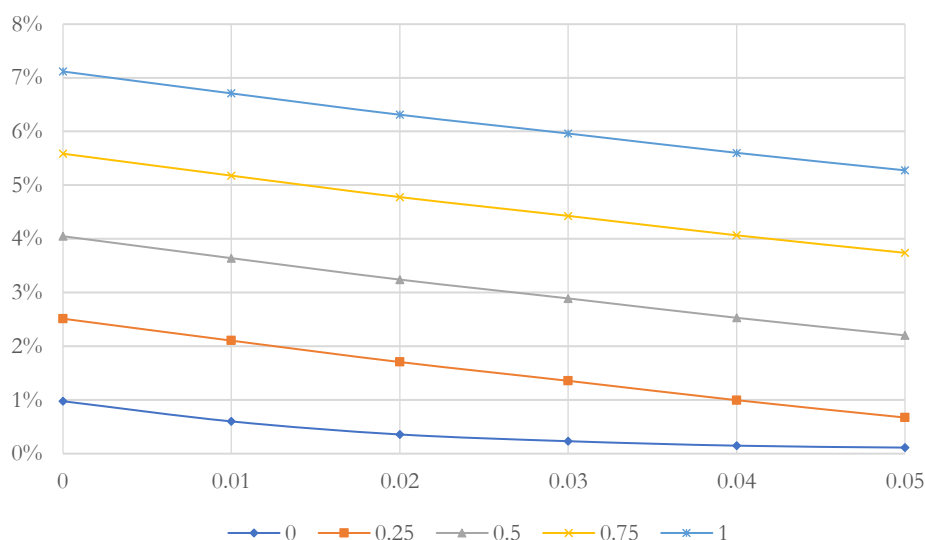
$$NPL^H = \sum_{s=1}^S \theta^s \times \left( \alpha \times Prob \left[ \frac{NW^i + EQ^i}{TA^i} < 0 \right] + Prob \left[ \frac{NW^i + EQ^i}{TA^i} < \left( \frac{S^i}{TA^i} \times \widehat{IP}^s \right) - \frac{TR^i}{TA^i} \right] \right) \quad (22)$$

where  $NPL^H$  is the impact of the pandemic on households,  $\theta^s$  is the share of employment in sector  $s$  over total employment,  $\alpha$  the proportion of nonfinancial corporations with negative equity prior to the COVID-19 pandemic that become insolvent as a result of the pandemic,  $\frac{NW^i + EQ^i}{TA^i}$  a proxy for the leverage ratio (net worth and equity divided by total assets),  $\frac{S^i}{TA^i} \times \widehat{IP}^s$

the impact of the pandemic on nonfinancial corporations, and  $\frac{TR^i}{TA^i}$  the transfers from the government as a share of total assets.

NPLs may thus arise from the proportion of nonfinancial corporations with negative equity prior to the COVID-19 pandemic that file for corporate insolvency as a result of the pandemic and from nonfinancial corporations that were having positive equity at the onset of the pandemic but were severely affected by it, in a way that the government support via transfers cannot fully compensate. We assume that households employed in the nonfinancial corporations filing for insolvency default on their loan payments. We lack granular data to make a more fine-tuned assumption, and therefore, our results can be seen as a worst-case rather than a baseline scenario.

Figure 18 shows the increase in the rate of NPLs to households as a result of corporate insolvencies under different assumptions regarding the extent of government support (x-axis) and the degree to which the COVID-19 pandemic triggers the insolvency of nonfinancial corporations with negative equity prior to the pandemic (chart legend). In the extreme situation without government support and with all the nonfinancial corporations with negative equity going to insolvency, the rate of NPLs in the household sector can increase above 7%. This is, however, an unlikely outcome, given the extent of government support. If we consider that the transfers from the government to nonfinancial corporations account for 2% of their total assets and that the pandemic can trigger the insolvency of 25% of nonfinancial corporations with negative equity before the onset of the pandemic, the rate of additional NPLs reaches 2.1% (EUR 145 billion, as based on the amounts in Appendix A).

**Figure 18: NPLs in the Household Sector Derived from Corporate Insolvencies**

Notes: The y-axis shows the share of NPLs of households that may arise as a result of corporate insolvencies, under different assumptions regarding the transfers from the government (x-axis) and the degree to which nonfinancial corporations with negative equity before the onset of the pandemic would become nonperforming as a result of the pandemic (see legend).

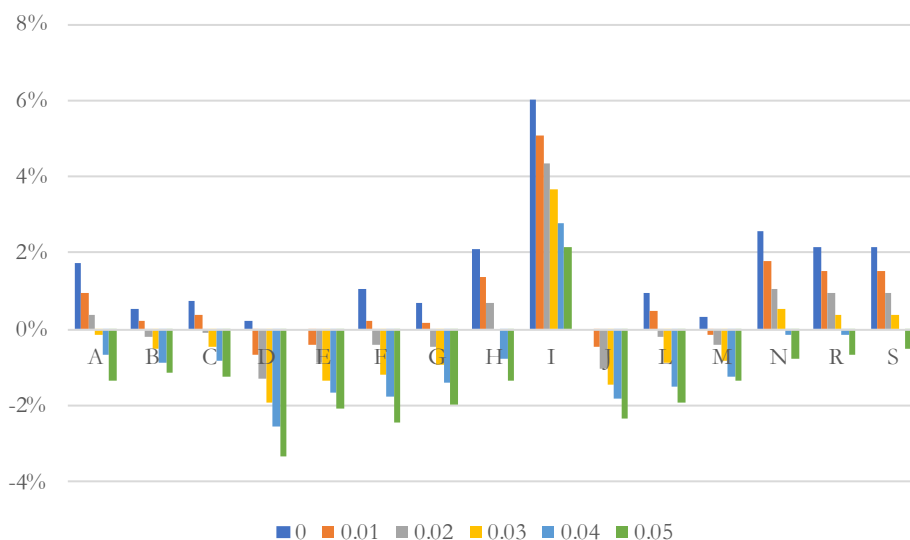
Source: Author's analysis.

In the above calculations, we consider that transfers from the government are equally distributed across sectors of nonfinancial corporations. As a result, those sectors most affected by the pandemic are treated the same as other sectors less severely affected. Extending government support without considering the impact of the pandemic can have the unintended consequence of helping nonfinancial corporations in a vulnerable situation before the pandemic (with negative equity) and that should probably exit the market to continue their operations throughout the pandemic.

This is more clearly seen if we assume that the pandemic does not trigger the insolvency of any nonfinancial corporations that entered it with negative equity (value of 0 for the legend in Figure 18). Figure 19 shows the increase, in percentage points, of the share of nonfinancial corporations with negative equity across different sectors and under different scenarios of government support. What emerges from these potential outcomes is a significant increase for sector I (accommodation and food service activities), which is not replicated by any other sector. Extending government support equally across sectors leads to reducing the number of nonfinancial corporations with negative equity in the other sectors and only slowly decreases the increase for sector I (accommodation and food service activities). This does not seem the most optimal way of addressing difficulties in nonfinancial corporations. Targeted interventions by the government across sectors, depending on the impact of the COVID-19 pandemic, seem to be justified.



**Figure 19: Change in the Share of Nonfinancial Corporations with Negative Equity under Different Assumptions of Transfers from Governments**



Notes: Each bar shows the difference in the share of nonfinancial corporations with negative equity before the COVID-19 pandemic and after the onset of the COVID-19 pandemic, considering that transfers from government vary between 0 and 5% of the total balance sheet of nonfinancial corporations and that no nonfinancial corporation with negative equity at the onset of the COVID-19 pandemic becomes insolvent. Positive (negative) values indicate that the share of nonfinancial corporations with negative equity is higher (lower) than at the onset of the COVID-19 pandemic. A stands for agriculture, forestry, and fishing; B for mining and quarrying; C for manufacturing; D for electricity, gas, steam, and air conditioning supply; E for water supply, sewerage, and waste management and remediation activities; F for construction; G for wholesale and retail trade and repair of motor vehicles and motorcycles; H for transporting and storage; I for accommodation and food service activities; J for information and communication services; L for real estate activities; M for professional, scientific, and technical activities; N for administrative and support service activities; R for arts, entertainment, and recreation; and S for other services activities.

Source: Author's analysis.

If we assume the same targeted intervention as in Section IV.D, whereby government support does not reach all sectors equally but is directed toward the most affected nonfinancial sectors, the increase in the share of NPLs to households resulting from corporate insolvencies is 0.65% (EUR 45 billion according to the data in Appendix A). Again, simply by using more efficiently the transfers from the governments, the amount of additional NPLs decreases by EUR 100 billion in the euro area.

## V. NPLs and the Loss-Absorbing Capacity of Banks

Before measuring the loss-absorbing capacity of banks on the basis of their accumulated equity and their leverage ratio, we make some considerations in the next section about bank resilience and the importance of maintaining a sound banking system through recessions. Afterwards, we propose some metrics to analyze the capacity of the banking system to

absorb losses derived from NPLs and apply these metrics to the estimate of NPLs computed in the previous section and to other previous crises. We use the estimates in Figure 20 for NPLs, derived in Section IV.D and Section IV.F.

**Figure 20: Values Attributed to Main Variables in the Estimation of NPLs Arising from the COVID-19 Pandemic in Relation to Loans to Households**

Sector	Government support	Increase in rate of NPLs	Additional NPLs in billion euros	Increase in rate of NPLs over loans to nonfinancial corporations and households
Nonfinancial corporations	Not targeted	7.07%	797	4.38%
	Targeted	6.53%	736	4.05%
Households	Not targeted	2.1%	145	0.80%
	Targeted	0.65%	45	0.25%
Total	Not targeted	—	942	5.18%
	Targeted	—	781	4.30%

Source: Author's analysis.

### A. Discussion of Bank Resilience in Times of COVID-19

In general terms, stress on nonfinancial corporations and households usually leads to an increase in NPLs. The academic literature has found that the evolution of the real economy plays a fundamental role in the evolution of NPLs (Beck, Jakubik, and Piloiu 2015; Ghosh 2015). When considering the timing for the recognition of NPLs, it is important to note that the definition of NPLs entails nonpayment over 90 days. As such, the recognition of new NPLs tends to occur with some delay in comparison to the start of an economic recession.<sup>21</sup>

Therefore, the impact of the stress in the real economy on the balance sheet of banks can then be expected to occur gradually.<sup>22</sup>

<sup>21</sup> The definition of NPLs also introduces the criterion of the borrower being unlikely to pay, in parallel to the 90-days past-due criterion. As a result, earlier recognition of NPLs could be possible if the unlikely to pay criterion is used. Since 2015, the recognition of NPLs under the unlikely to pay criterion has varied between 30% and 40% of total NPLs (EBA 2019).

<sup>22</sup> Over the long term, for banks using internal ratings models for the computation of capital requirements for credit risk, the increase in credit risk may be reflected in the main parameters used in these models (probabilities of default, loss given default, and exposures at default), leading to an increase in risk weights associated with credit exposures, even if they are not recognized as nonperforming (or defaulted).

The increase in provisions resulting from the recognition of additional NPLs related to the COVID-19 pandemic is expected to reduce profits (or increase losses) and equity. When banks are simultaneously subject to that reduction and amidst a challenging and uncertain macroeconomic environment,<sup>23</sup> the optimal individual response of banks may be to restrict new lending and deleverage to avoid the need to raise new capital or to reduce dividends. This response is, however, not optimal for the banking sector as a whole. Such behavioral response of banks is empirically documented in the academic literature (Berger and Udell 1994; Bernanke and Lown 1991; Gropp et al. 2018). Even if banks may have taken measures in the form of voluntarily reducing buffers, an overall reduction in new lending can be expected over the medium term, in the absence of policy actions by regulatory and supervisory authorities.

In a comparison with the GFC, the solvency position of banks at the end of 2019 was better than in 2007, with higher liquidity and capital ratios (the latter, both in absolute and in risk-weighted terms). Besides, prudential authorities have tools available to address the effects of the COVID-19 pandemic on existing and on new lending. The current regulatory requirements establish that internal ratings models should use parameters through the cycle (TTC) rather than only as a point in time (PIT). Consequently, the impact of sudden recessions on prudential requirements can be attenuated. Other actions taken by prudential authorities refer to the release of previously built countercyclical capital buffers, guidance to make sure that regulatory provisions (especially cyclical capital buffers) do not impede the provision of credit to the real economy, and the retention of profits. In the accounting domain, the expected credit loss approach in International Financial Reporting Standard (IFRS) 9, put in place after the GFC, requires banks to anticipate provisioning of those credit exposures with a significant deterioration in credit risk (these exposures are moved into Stage 2, requiring the recognition of provisions for the whole lifetime of the exposure), without the need to wait for the recognition of the exposure as nonperforming (ESRB 2017; ESRB 2019).

## **B. Estimating the Loss-Absorbing Capacity of Banks**

In view of the potential amount of NPLs to be generated by the COVID-19 pandemic, we analyze the capacity of banking systems subject to a non-risk-weighted capital requirement (that is, the leverage ratio) to absorb the losses caused by the COVID-19 pandemic.

We consider that banks are subject to two binding prudential requirements (leverage ratio or risk-weighted capital ratios). We define these two requirements as:

$$LR_t = \frac{OF_t}{TA_t} \quad (23)$$

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<sup>23</sup> Banks have been operating with low levels of profitability, also derived from legacy assets from the GFC and from the macroeconomic environment of low growth and low interest rates.

$$CR_t = \frac{OF_t}{RWA_t} = \frac{OF_t}{RWD_t \times TA_t} \quad (24)$$

where  $LR_t$  denotes the leverage ratio,  $OF_t$  own funds,  $TA_t$  total assets,  $RWA_t$  risk-weighted assets, and  $RWD_t$  risk-weight densities (defined as risk-weighted assets divided by total assets).

If we operate further and assume a prudential requirement of 3% for the leverage ratio ( $\overline{LR} = 0.03$ ) and of 8% for the risk-weighted capital requirement ( $\overline{CR} = 0.08$ ), we obtain:

$$OF_t = LR_t \times TA_t = CR_t \times RWD_t \times TA_t$$

$$0.08 \times RWD_t = 0.03$$

$$RWD_t = \frac{0.03}{0.08} = 0.375 \quad (25)$$

Therefore, for banks with relatively low risk-weight densities (below 37.5%), the leverage ratio is the binding prudential requirement (see also Bank of England 2014). Given the low risk-weight densities shown by banks in the last years (Basten and Sánchez Serrano 2019), we can assume that the risk-weighted capital requirement is sometimes not binding on banks.

Losses are absorbed by the existing capital of the banks, and the leverage ratio measures the loss-absorbing capacity of the banking system. That loss-absorbing capacity can be thought to be the amount of own funds of the bank in excess of the prudential requirement of the leverage ratio. We refer to this as excess of own funds.

We express the excess of own funds in absolute terms as follows:

$$EOF_t = \frac{OF_t - (\overline{LR} \times TA_t \times (1-\theta))}{(1-\overline{LR})} \quad (26)$$

where  $EOF_t$  refers to the excess of own funds,  $\overline{LR}$  to the binding prudential requirement for the leverage ratio (that is, 3%),  $TA$  to total assets, and  $\theta$  to the reduction in balance sheet size through deleverage. The expression  $(1 - \overline{LR})$  is included to consider that a loss reduces the total balance sheet of the bank as well, so the own funds required to meet the binding leverage ratio need to be slightly adjusted.

Equation (26) can also be expressed as a share of total assets:

$$eof_t = \frac{OF_t - (\overline{LR} \times TA_t \times (1-\theta))}{TA_t \times (1-\overline{LR})} \quad (27)$$

where, in addition to the variables defined for Equation (26),  $eof_t$  refers to the excess of own funds as a share of total assets.

Equation (26) and Equation (27) show a positive contribution of deleverage on the loss-absorption capacity of banks. From the point of the view of an individual bank, deleverage is an available valid strategy in a crisis, as it immediately increases the bank's capacity to absorb losses.

In the next step, we compute how much NPLs should increase to fully exhaust the excess of own funds and breach the binding prudential requirement for the leverage ratio. The increase of NPLs that would bring the leverage ratio of banks to 3% is equal to:

$$\Delta npl_t = \frac{(EOF_t \times (1+\gamma)) + (\alpha \times TL_t \times (1-npl_t))}{(TL_t \times (1-\theta_L)) - (EOF_t \times (1+\gamma))} \quad (28)$$

where  $npl_t$  is the rate of NPLs (calculated as the ratio of NPLs to total loans),  $EOF$  is the excess of own funds,  $\gamma$  is the recovery value from NPLs (or the amount of credit losses to be absorbed),  $\alpha$  is the provisioning of performing loans (Stage 1 and Stage 2 loans under IFRS 9),  $TL$  refers to total loans, and  $\theta_L$  is the reduction in total loans. On the latter, the reduction in total loans does not necessarily imply a reduction in total assets, as banks may opt for intensifying other activities and business lines. As in the previous equation, the expression  $(EOF_t \times (1 + \gamma))$  is deducted from total loans in the denominator as the absorption of these losses reduces the total amount of loans.

According to Equation (28), the necessary increase of the rate of NPLs to exhaust the excess of own funds is a positive function of the existing provisioning for performing exposures, of the expected recovered amounts from NPLs, and of the existing excess of own funds. These are three important channels through which the resilience of the banking sector can be strengthened, particularly before the shock hits the economy.

### C. Increasing the Capacity to Withstand Losses from NPLs

Equation (28) reveals three important factors that shape the resilience of banks against an increase in NPLs and that have been the focus of intense policy work in the aftermath of the GFC:

- (1) Provisioning before the loan becomes nonperforming ( $\alpha$ ). Under incurred loss approaches in accounting, a bank would not be allowed to recognise any loss from loans for which a default event has not occurred. With the introduction of expected credit loss approaches after the GFC, some credit losses can be recognized from their inception (ESRB 2017; ESRB 2019; Sánchez Serrano 2018). So, the capacity of the bank to anticipate downturns and to provision in advance can positively contribute to increasing its resilience once the shock materializes.
- (2) The amount recovered from NPLs ( $\gamma$ ). There are several factors that can influence how much a bank can recover from a loan that becomes nonperforming. Starting with the most obvious, collateralized lending allows banks to recover higher amounts than unsecured lending. But factors like efficiency in courts and the existence of developed secondary markets for NPLs can also contribute to increase

the values recovered from them (Baudino and Yun 2017).

- (3) The reduction in total loans ( $\theta_L$ ). Indeed, an automatic way to gain resilience for a bank is to reduce the size of the loan portfolio so that existing equity covers a smaller loan portfolio. As mentioned before, this solution can be optimal for an individual bank, but when considered at the aggregate can generate a credit crunch and intensify the effects of the downturn.

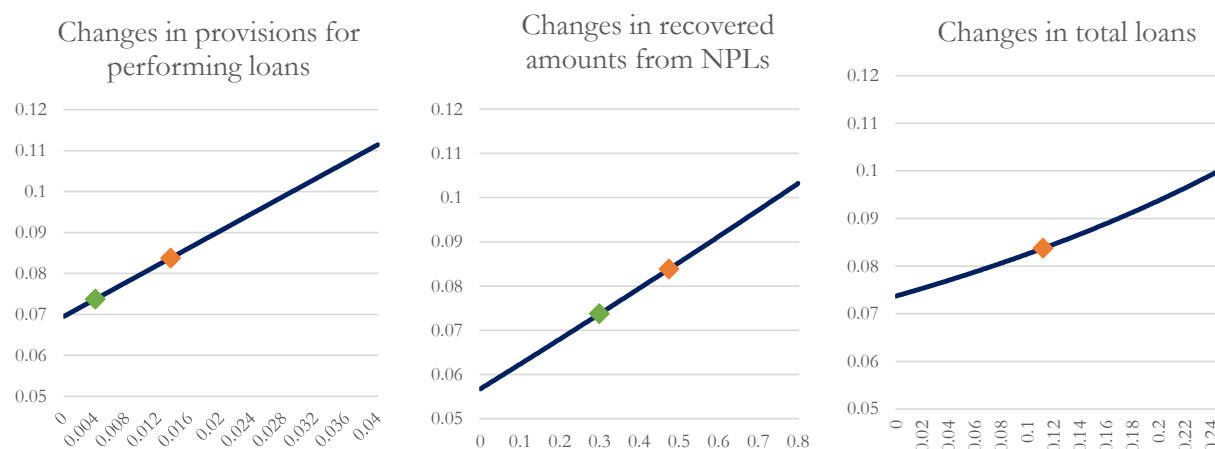
In the following paragraphs, we illustrate the importance of the three variables above by means of a hypothetical example. Let's assume a loan portfolio of 100 currency units (CU), where 2 CU are nonperforming at the onset of the COVID-19 pandemic and where the bank has an excess of own funds of 5 CU. We assume that banks can recover 30% of the amount of NPLs, and that accumulated provisions for performing loans represent 0.4% of them.<sup>24</sup> Figure 21 shows in the y-axis the evolution of the change in the rate of NPLs that exhausts the excess of own funds of the bank for different values of the accumulated provisions for performing loans, of the recovered amounts from NPLs, and of the reduction in total loans, separately (shown in the x-axis).

Starting with the left panel on accumulated provisions for performing loans, our initial conditions (green diamond in the left-side chart of Figure 21) lead to a rate of NPLs to exhaust accumulated equity close to 7.4%. To increase that rate of NPLs by 1 percentage point to 8.4% requires that provisions increase more than threefold (from 0.4% to 1.3%), as shown by the orange diamond. In the case of recovered amounts, recovering 30% of NPLs makes the bank resilient until a rate of NPLs reaches slightly above 7.3% (green diamond in the middle chart of Figure 21). As in the previous case, if we want the rate of NPLs that exhaust own funds to increase by 1 percentage point, the recovered amounts from NPLs should be around 0.5. In other words, banks should recover approximately 50% from the value of NPLs (orange diamond in the middle chart of Figure 21). Finally, in the case of reductions in total loans, banks need to reduce their total loans by about 12% to increase the rate of NPLs that exhaust their own funds (orange diamond in the right chart of Figure 21).

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<sup>24</sup> The latter being in line with the values reported in the EBA Risk Dashboard for pre-pandemic periods (EBA 2020b).

**Figure 21: Impact of Provisioning, Recovered Amounts from NPLs, and Deleveraging on the Rate of NPLs That Exhaust the Excess of Own Funds of Banks**



Notes: The chart on the left shows the rate of NPLs that exhaust the excess of own funds of banks with different intensities in provisioning (as a percentage of total loans). The chart in the middle shows the rate of NPLs that exhaust the excess of own funds of banks with different recovered amounts from NPLs (as a percentage of the gross carrying amount of the loan). The chart on the right shows the rate of NPLs that exhaust the excess of own funds of banks with different values of the amount of total loans on the balance sheet of the bank (as a percentage change over the outstanding amount in the previous period). Green diamonds represent the initial situation, mirroring the status of the European banking system at the onset of the COVID-19 pandemic, and the orange diamonds represent the value of each variable that increases the rate of NPLs that exhaust own funds by 1 percentage point.

Source: Author's analysis.

Although the three parameters increase the rate of NPLs that exhaust the excess of own funds, their effect presents interesting differences. Indeed, changes in the recovered amounts from NPLs have the largest effect on the resilience of the bank. Besides, the curve for changes in total loans seems to be slightly convex. There is an additional point to consider here. As changes in accumulated provisions and in the recovered amounts from NPLs take time to materialize and are most likely not adopted in times of crisis, changes in total loans may be the only existing alternative for banks to increase their resilience during a crisis. But this strategy seems to be the least effective in overall terms. That dynamic points to the importance of “repairing the roof during sunny days.”

#### D. Testing the Loss-Absorbing Capacity of Banks in Several Scenarios

In this section, we compute the excess own funds and the increase in NPLs that would lead banks to breach the leverage ratio requirement under several hypothetical scenarios. We start from Equation (26) and Equation (28) and use the values shown in Figure 22.

**Figure 22: Values for the Main Variables and Parameters to Assess the Loss-Absorbing Capacity of Banks in the Euro Area**

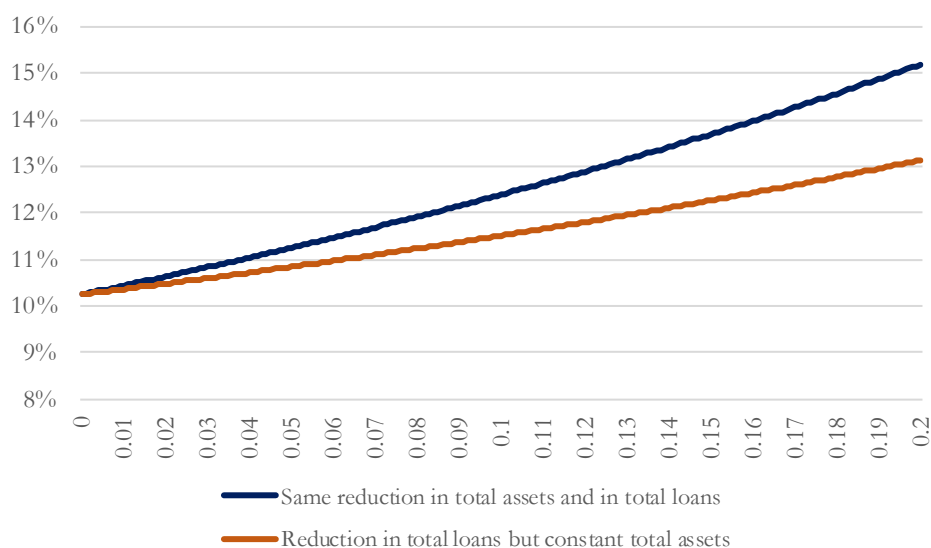
Parameter	Value	Source and other information
$OF_t$	1,798	ECB Consolidated Banking Data, euro area, end 2019, bn EUR, total equity, domestic and stand-alone banks
$\overline{LR}$	0.03	According to Basel III as implemented in the EU
$TA_t$	24,926	ECB Consolidated Banking Data, euro area, end 2019, bn EUR, domestic and stand-alone banks
$TL_t$	16,386	ECB Consolidated Banking Data, euro area, end 2019, bn EUR, domestic and stand-alone banks
$\gamma$	0.35	Taken from Chart 10 of ESRB (2021b)
$\alpha$	0.0043	EBA Risk Dashboard, end 2019, computed as the share of loans in stages 1 and 2 multiplied by their coverage, divided by total loans
$npl_t$	0.027	EBA Risk Dashboard

Sources: EBA 2020b; ECB 2021a; ESRB 2021b; author's analysis.

With this specification, the increase in the rate of NPLs to exhaust the excess of own funds should be slightly above 10% in case the bank does not decrease its amount of total assets and total loans (equivalent to 0 in the x-axis of Figure 21). As shown in Section V.B, deleverage, both in terms of total loans and total assets, slightly increases the loss-absorption capacity of banks.



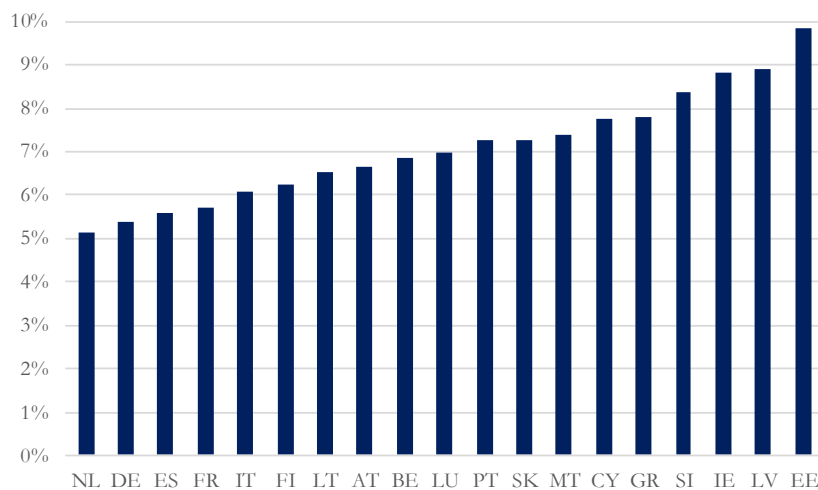
**Figure 23: Rate of NPLs That Exhaust the Excess of Own Funds of Banks under Different Assumptions Regarding Total Assets and Total Loans**



Notes: The x-axis shows the reduction in total loans in the balance sheet of banks and the y-axis NPL rates. The blue line shows the rate of NPLs that exhaust the excess of own funds over the 3% leverage ratio requirement of banks, considering that banks reduce their balance sheets and their lending at the same rate. The orange line shows the rate of NPLs that exhaust the excess of own funds over the 3% leverage ratio requirement of banks, considering that banks reduce their lending but maintain their total balance sheet size constant. All calculations made according to the values in Figure 22 and Equation (28).

Source: Author's analysis.

The implicit ratio between total equity and total assets in our calculations is about 7.2%. However, as shown by Figure 24, there is large heterogeneity in the leverage ratio across the euro area. While some banking systems exhibit values of the leverage ratio close to 10%, leverage ratios of banks in other countries take values around or below 6%. In the latter group, we find the largest national banking systems: Italy, Spain, France, Germany, and the Netherlands.

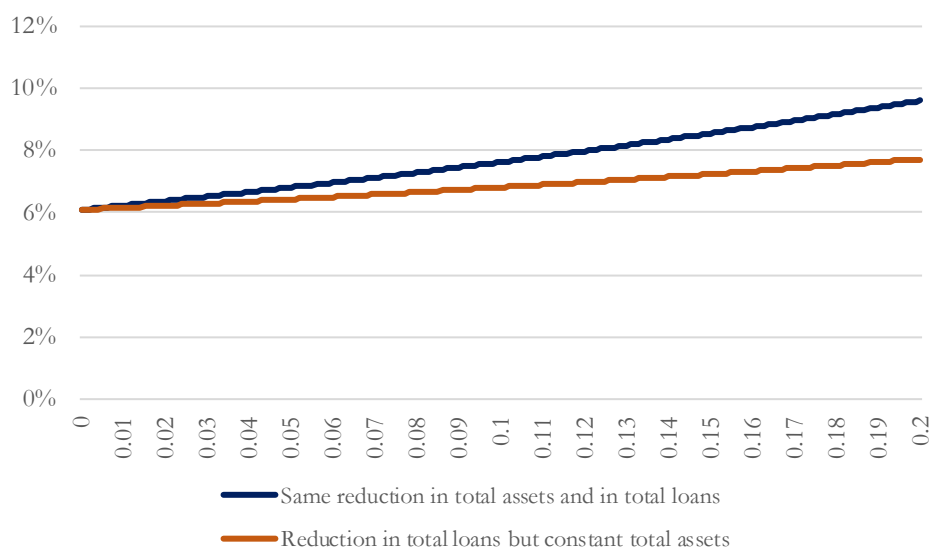
**Figure 24: Leverage Ratio in Euro Area Banking Systems**

Notes: Data refers to the fully phased-in leverage ratio as reported in the EBA Risk Dashboard (EBA 2020b), with reference date December 2020.

Source: EBA 2020b.

In Figure 25, we show the rate of new NPLs that exhaust the excess of own funds, with a leverage ratio of 5.5%. In this case, the loss-absorption capacity of the banking system is significantly lower than in Figure 23, as an increase of 6% in the rate of NPLs is enough to exhaust the excess of own funds in banks.

**Figure 25: Rate of NPLs That Exhaust the Excess of Own Funds of Banks under Different Assumptions Regarding Total Assets and Total Loans, Assuming a Leverage Ratio of 5.5%**



Notes: The x-axis shows the reduction in total loans in the balance sheet of banks and the y-axis NPL rates. The blue line shows the rate of NPLs that exhausts the excess of own funds over the 3% leverage ratio requirement, considering that banks reduce their balance sheets and their lending at the same rate. The orange line shows the rate of NPLs that exhausts the excess of own funds over the 3% leverage ratio requirement, considering that banks reduce their lending but maintain their total balance sheet size constant. All calculations made according to Equation (28) and the values in Figure 22, except for total assets and own funds, the latter being fixed as 5.5% of total assets.

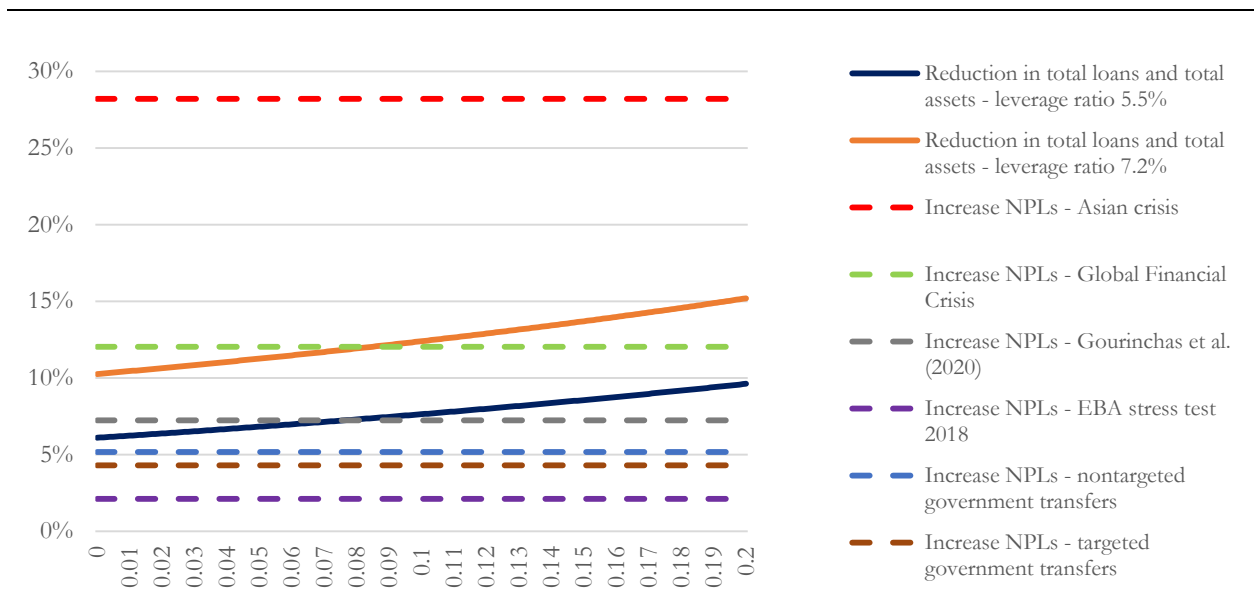
Source: Author's analysis.

We look now at the possible increase in NPLs caused by the COVID-19 pandemic. Together with our estimates from Section IV (5.18% and 4.30%), we use the increase in the adverse scenario of the 2018 EBA stress test (EBA 2018), the estimate in Gourinchas et al. (2020), the average increase in NPLs in the GFC in the euro area countries, and the increase in NPLs in the 1997–1998 Asian financial crisis. The two latter are taken from the database of Laeven and Valencia (2020).

The results of this comparison are shown in Figure 26. We appreciate first that an increase of NPLs as reported in Figure 20 could be absorbed by the euro area banking system, and the same applies when considering the results of the 2018 EBA stress test exercise (purple dotted line). However, the line for nontargeted government measures gets rather close to the dark blue line associated with a leverage ratio of 5.5%. So, for those jurisdictions with lower values of the leverage ratio and nontargeted government support measures, the expected increase in NPLs can threaten the solvency of the banking system as a whole, particularly if banks do not deleverage. Similarly, in the case of the estimate in Gourinchas et al. (2020), which does not consider government support, absorbing the derived losses can be problematic for those jurisdictions with lower leverage ratios. An increase in NPLs such as the one seen in the GFC in the euro area countries (green dotted line) can be absorbed

only by jurisdictions with higher leverage ratios and only with substantial deleveraging. Otherwise, the related losses exceed the accumulated own funds of banks. Finally, a scenario replicating the Asian crisis in terms of NPLs results in an insufficient capacity of the euro area banking system to absorb losses. This scenario seems nowadays far from the baseline expectations.

**Figure 26: Increases in the Rates of NPLs That Exhaust the Excess of Own Funds and Selected Rates of NPLs**



Notes: The x-axis shows the reduction in total loans in the balance sheet of banks and the y-axis NPL rates. The orange and dark blue lines represent the rate of NPLs that exhaust the excess of own funds over the binding leverage ratio requirement for the euro area, assuming the same reductions of total assets and total loans. The dotted lines show NPL rates from selected previous financial crises and from the latest EBA stress test, Gourinchas et al. (2020), and our estimations in Figure 20. Gourinchas et al. (2020) does not take into account government support measures.

Sources: EBA 2018; Gourinchas et al. 2020; Laeven and Valencia 2020; author's analysis.

In general terms, the estimates of NPLs arising from the COVID-19 pandemic seem to be significantly lower than those observed in previous crises (such as the GFC or the Asian crisis), despite the large impact of the pandemic on the real economy. The extent of government support, the existing banking system's net worth, and the limited duration of the pandemic may be factors explaining this difference with previous episodes of stress. Returning to the fourth question posed in the introduction (how many NPLs can banks absorb given their current non-risk-weighted capital levels), our findings point toward a resilient banking system in the euro area in aggregated terms. Nonetheless, individual institutions (or groups of institutions) may be affected as a result of their initial solvency position and the concentration of their exposures.

## VI. Conclusions

We have estimated the impact of the COVID-19 pandemic on nonfinancial corporations and households and whether that impact could lead to a material new wave of NPLs that could threaten the solvency of the banking system. We have used the sectoral balance sheets and flows statements of a stylized economy (without the external sector) in our simulations to develop estimates of the impact of the pandemic, the potential increase in NPLs, and the capacity of the banking system to absorb the related losses. The concept of net worth has also been at the core of our analysis.

Our methodology has several important caveats that must be mentioned here. Our stylized economy does not consider the external sector, and we do not assess second-round effects extensively. Second-round effects could worsen the impact of the pandemic on the real economy through cross-sectoral interconnections and dependencies. Although we have made extensive use of the available short-term data for nonfinancial corporations and households, our calculations, made at an aggregated level, are based on many assumptions and should be regarded as approximations in terms of size, rather than as accurate point estimates. The assumption that the ratios of nonfinancial corporations follow a normal distribution must be mentioned here too.

Our main findings, when applied to the euro area, can be summarized as follows.

First, the COVID-19 pandemic is unevenly affecting nonfinancial corporations, depending on the goods and services they provide. Those providing essential goods or services that can be consumed remotely are less severely affected than nonfinancial corporations providing goods and services that cannot be consumed remotely and that are not essential. The impact on households depends on the percentage of the population working in the most affected sectors. Given the different economic structures across the euro area, the impact of the COVID-19 pandemic is heterogeneous across countries.

Second, there is a strong correlation between the decrease in sales of nonfinancial corporations and the duration of the pandemic, measured through the measures taken to limit economic activity. The longer the duration of the pandemic, the deeper its impact on the economy, particularly on the most affected sectors. Our scenarios foresee a drop in corporate turnover of about 30% of the accumulated net worth of the sector by the end of 2021, before taking government support into account.

Third, in scenarios where the pandemic continues, albeit with less intensity, the only way to prevent a large increase in NPLs is through very large transfers from the governments to nonfinancial corporations, which can be coupled with large sales of assets by corporations themselves. An estimated scenario for government support envisages an increase in NPLs above EUR 700 billion. Designing transfers from the government that are targeted to the most affected nonfinancial corporations can have a large beneficial effect. Targeted government support can also mitigate the extent of NPLs from household loans as a result of corporate insolvencies.

Fourth, defining the loss-absorbing capacity of the banking system in terms of the excess of own funds over the binding leverage ratio requirement, euro area banks seem to be resilient enough, in aggregate, to absorb the losses caused by the COVID-19 pandemic on the real economy, without the need to decrease their lending activities. Our findings are aligned to those by Gourinchas et al. (2020), Aiyar et al. (2021), and OECD (2021). The initial level of own funds is key to defining the loss-absorbing capacity of banks. Those banks and national banking systems that entered the COVID-19 crisis in a weaker position may find themselves close to breaching the binding leverage ratio requirement in case the related credit losses materialize. Deleverage appears to be the most likely reaction in times of stress, albeit it is not much effective in increasing the resilience of banks.

With the benefit of hindsight, we have not observed an increase in NPLs in the range of EUR 700 billion, as discussed. Reviewing our calculations, we can attribute this to two main causes: (i) the extent of government support to nonfinancial corporations, probably going beyond our assumptions, and (ii) the capacity of the economy to adapt to the new conditions, mainly referring to the possibilities of teleworking.<sup>25</sup> These are also important lessons in increasing the understanding of the impact of pandemics on the economy.

Finally, there is still some uncertainty about the evolution of the pandemic and how the economy will emerge from the pandemic, which business models are going to be impaired permanently, and which ones will succeed. Our paper contributes to the effort to understand the impact of the COVID-19 pandemic on the economy and on the financial system, but it says little about how the economy will look like in a few years' time.

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<sup>25</sup> The termination of government support measures in the most recent months may also trigger an increase in NPLs (ESRB 2021a).

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## VIII. Appendixes

### Appendix A: Balance Sheet of Our Stylized Economy, with Amounts for the Euro Area at the End of 2019

**Figure 27: Stylized Balance Sheet of the Euro Area Economy, at the End of 2019**

<u>Households</u>							
Assets		Liabilities		Inflows		Outflows	
Real Estate	32,921	Loans	6,896	Wages	5,751	Interest of loans	237
Financial assets	22,454	Future tax liabilities	na	Interest	392	Consumption	6,393
Pension rights	3,468	Other liabilities	900	Dividends	1,188	Taxes	3,361
Insurance assets	na	Net worth	52,814	Transfers	2,227	<i>Savings (change in net worth)</i>	2,708
Other assets	1,767			Other inflows/outflows	3,141		
<u>Nonfinancial corporations</u>							
Assets		Liabilities		Inflows		Outflows	
Inventories	na	Loans	11,284	Capital inflows	1,572	Wages	3,822
Customer receivables	3,426	Bonds	1,524	Sales	4,792	Interest of loans	203
Financial assets	25,501	Payables to suppliers	3,265	Transfers	738	Interest of bonds	82
Fixed assets	14,776	Pension rights	404			Amortisation	1,227
		Future tax liabilities	na			Dividends	1,082
		Other liabilities	1,415			Other inflows / outflows	385
		Net worth	3,209			<i>Profit (change in net worth)</i>	301
		Shares and other equity	22,602				
<u>Financial intermediaries</u>							
Assets		Liabilities		Inflows		Outflows	
Loans	20,549	Deposits	28,188	Interest from loans	695	Wages	247
Shares	25,245	Technical reserves	9,300	Dividends	88	Interest bonds	462
Bonds	18,585	Pension rights	na	Insurance premia	422	Dividends	358
Real Estate	18,720	Bonds	8,119	Capital gains	7	Loan losses	50
		Other liabilities	8,513	Asset management fees	na	Insurance claims	na
		Net worth	911			Other inflows / outflows	0
		Shares and other equity	28,068			<i>Profit (change in net worth)</i>	95
<u>Government</u>							
Assets		Liabilities		Inflows		Outflows	
Future taxes and fees	na	Pension rights	na	Taxes	5,477	Interest of bonds	191
Fixed assets	7,525	Bonds	9,371	Fees	na	Consumption	631
Shares	2,310	Other financial liabilities	2,167	Capital revenue	60	Investment	333
Other financial assets	1,703			<i>Deficit (surplus)</i>	71	Transfers	2,965
						Wages	1,179
						Other expenses	310

Notes: Values in billion euro for the main categories of the balance sheet and flow statement of households, nonfinancial corporations, financial intermediaries, and the government, taken from the sectoral annual accounts; "na" refers to those captions not available in current disclosures.

Sources: ECB 2021c; author's calculations.

## **Appendix B: The Impact of the COVID-19 Pandemic on Governments and on the External Sector**

Confronted with the COVID-19 crisis, the government sector is expected to simultaneously see a decrease in taxes and fees derived from the reduction in economic activity and an increase in (1) transfers to households (mainly, unemployment benefits) and to nonfinancial corporations, and (2) consumption (health care expenses). As a result, deficits are expected to substantially increase. In theory, if such deficits are temporary, recovery is solid, and there is a clear path of reduction of the stock of sovereign debt, there should not be large concerns about the long-term sustainability of sovereign debt.

Considering the external sector, the COVID-19 pandemic affects over the long term the two main components of the balance of payments (current and capital accounts) and the financial account. Given the tight commercial relations among different countries in the world, where supply chains have become global for many goods, exports and imports can change depending on the nature of the underlying goods and on how they are impacted by the pandemic. Regarding the provision of cross-border services, the lockdown restrictions have affected those that cannot be provided remotely (such as tourism), also impairing the current account of those countries where these services have an important weight in the economy. Concerning the capital account, an expected retrenchment of cross-border capital flows can also negatively affect investment. Besides, cross-border banking and financial flows, also included in the financial account, can vary largely as a result of the COVID-19 pandemic, either as a result of a stronger focus on domestic activities (“home bias”) or as a “flight to safety” toward countries less affected by the decrease in economic activity, among other considerations.

## Appendix C: Further Details on the Impact of the Pandemic across Sectors of Nonfinancial Corporations

Figure 28 shows the degree to which each sector is estimated to provide essential goods and services and the extent to which they can be consumed remotely, according to Section III.B.

**Figure 28: Essential and Remote Characteristics of Goods and Services Provided by Sector**

Sector	(A) Essential	(B) Remote	(A) x(B) Impact
Agriculture, forestry, and fishing	0.87	0.3	3.82
Mining and quarrying	0.33	0.1	30.00
Manufacturing	0.41	0.4	6.12
Electricity, gas, steam, and air conditioning supply	1.00	1.0	1.00
Water supply, sewerage, and waste management and remediation activities	1.00	1.0	1.00
Construction	0.45	0.1	22.00
Wholesale and retail trade and repair of motor vehicles and motorcycles	0.26	0.7	5.42
Transporting and storage	1.00	0.3	3.33
Accommodation and food service activities	0.13	0.2	40.00
Information and communication services	1.00	0.9	1.11
Real estate activities	0.01	0.6	166.67
Professional, scientific, and technical activities	1.00	1.0	1.00
Administrative and support service activities	0.01	1.0	100.00
Arts, entertainment, and recreation	0.01	0.2	500.00
Other services activities	0.01	0.5	200.00
<i>Pro memoria</i> : Financial and insurance services	1.00	1.0	1.00

Notes: The table shows the degree to which the goods and services provided by each sector are essential and can be consumed remotely, as explained in section III.B. The value of 0.01 is attributed instead of zero, in order not to arrive at an undetermined expression.

Source: Author's analysis.

The breakdown of gross value added of nonfinancial corporations, which we use to obtain the aggregate for nonfinancial corporations, by sector does not fully match the NACE industry classification codes. As shown in Figure 29, we had to make some adjustments,

taking averages when necessary. First, the difference between industry (except construction) and manufacturing, as reported by Eurostat, is mapped to (1) mining and quarrying, (2) electricity, gas, steam, and air conditioning supply; and (3) water supply, sewerage, and waste management and remediation activities. Second, the Eurostat wholesale and retail trade, transport, accommodation and food service activities sector is divided equally between (1) wholesale and retail trade and repair of motor vehicles and motorcycles, (2) transporting and storage, and (3) accommodation and food service activities. Similarly, the NACE sectors professional, scientific, and technical activities; and administrative and support service activities are merged by Eurostat into one sector. The same occurs with arts, entertainment, and recreation; and other services activities, as they appear as one in the database of Eurostat.

**Figure 29: Equivalence between NACE Codes and Sector Reported in Gross Value Added by Eurostat**

Sector NACE code	Sector Eurostat
Agriculture, forestry, and fishing	Agriculture, forestry, and fishing
Mining and quarrying	Industry (except construction), with manufacturing separately reported
Manufacturing	
Electricity, gas, steam, and air conditioning supply	
Water supply, sewerage, and waste management and remediation activities	
Construction	Construction
Wholesale and retail trade and repair of motor vehicles and motorcycles	Wholesale and retail trade, transport, accommodation, and food service activities
Transporting and storage	
Accommodation and food service activities	
Information and communication services	Information and communication services
Financial and insurance services	Financial and insurance services
Real estate activities	Real estate activities
Professional, scientific, and technical activities	Professional, scientific, and technical activities; administrative and support service activities
Administrative and support service activities	
Arts, entertainment, and recreation	Arts, entertainment, and recreation; other service activities; activities of household and extraterritorial organizations and bodies
Other services activities	

Source: Eurostat; author's analysis.

Short-term business statistics by Eurostat do not cover all the sectors we consider in our analysis of the impact of the COVID-19 pandemic on nonfinancial corporations.



Figure 30 shows the necessary adjustments to reach full coverage of all NACE sectors.

**Figure 30: Adjustments Made to the Sectoral Impact of the Pandemic in Line with Short-Term Statistics and Data on Gross Value Added**

Sector (largest NACE code)	Adjustment to short-term statistics
Agriculture, forestry, and fishing	Based on the impact of the pandemic, we use “transporting and storage”
Mining and quarrying	
Manufacturing	
Electricity, gas, steam, and air conditioning supply	
Water supply, sewerage, and waste management and remediation activities	
Construction	
Wholesale and retail trade and repair of motor vehicles and motorcycles	
Transporting and storage	
Accommodation and food service activities	
Information and communication services	
Financial and insurance services	No data; we use “professional, scientific, and technical activities,” based on impact of the pandemic
Real estate activities	No data; we use data from “construction”
Professional, scientific, and technical activities	
Administrative and support service activities	
Arts, entertainment, and recreation	No data; we use data from “administrative and support service activities,” based on impact of the pandemic
Other services activities	No data; we use data from “administrative and support service activities,” based on impact of the pandemic

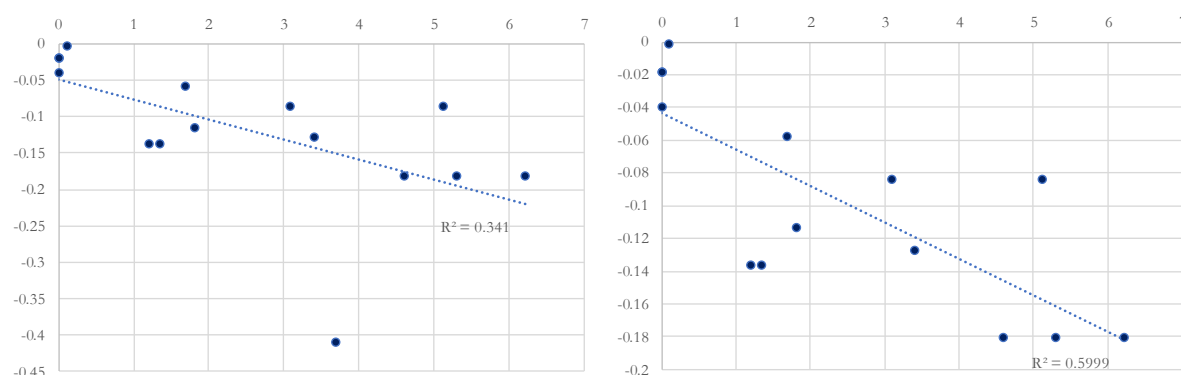
Notes: Impact of the pandemic refers to the calculations made in Section III.B. See also Table 6.

Source: Eurostat; author’s analysis.

The left panel of Figure 31 compares the impact of the COVID-19 pandemic computed according to Section III.A and the impact derived from the short-term statistics by Eurostat. We can observe a strong negative relation between the two approaches (higher impact translates into lower turnover). Sector I (accommodation and food service activities) can be

seen as an outlier, since the decrease in net turnover has been much larger than the impact of the pandemic, based on the nature of the goods and services provided as essential and remote. Excluding this sector from the computation increases the  $R^2$  coefficient to 0.6 (right panel of Figure 31).

**Figure 31: Impact of the COVID-19 Pandemic Computed as in Section III.A and as Derived from Short-Term Statistics on Turnover of Nonfinancial Corporations**



Notes: The x-axis shows the impact, in natural logarithms (ln), of the COVID-19 pandemic on nonfinancial corporations, according to Equation (1). The y-axis shows the decrease in turnover per sector derived from the short-term business statistics by Eurostat between March 2020 and December 2020, as derived in Section IV.B. The right panel excludes the sector accommodation and food service activities, which appears as an outlier in the left panel (very low value for the y-axis).

Source: Author's analysis.

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