The impact of monetary policy depending on the debt situation in the non-financial private sector: Evidence for the euro area

The economic restrictions due to the coronavirus pandemic have caused the debt situation in the euro area's non-financial private sector to deteriorate. This is reflected primarily in rising debt among non-financial corporations and households in relation to gross domestic product. The economic literature shows that higher debt in the non-financial private sector can amplify the impact of monetary policy measures. To date, however, hardly any empirical studies on this subject have focused on the euro area.

This article aims to reduce that gap in the literature. Using an econometric analysis based on a panel of the euro area countries, estimates are carried out for high-debt and low-debt regimes. The results show that non-financial corporations and households adjust their expenditure to a noticeably greater extent in response to a monetary policy shock in a high-debt regime than in a low-debt regime. These differences are more pronounced for non-financial corporations than for households.

At the current end of the data, most of the debt indicators for non-financial corporations and households in the euro area countries do not point to exceptionally high debt despite the less favourable situation resulting from the pandemic. This means that the current debt situation does not constitute a high-debt regime and is therefore unlikely to contribute to any significant amplification of the impact of monetary policy measures.

Introduction

Debt situation of euro area's non-financial private sector worsened by coronavirus pandemic

The economic restrictions due to the coronavirus pandemic have worsened the debt situation of the non-financial private sector in the euro area and its member countries. Income has fallen and borrowing has risen – in the case of non-financial corporations, significantly. The combined debt of non-financial corporations and households has increased perceptibly in relation to income.

Article investigates whether debt situation affects transmission of monetary policy

In view of these circumstances, this article investigates whether the debt situation in the non-financial private sector alters the transmission of monetary policy. Theoretical and econometric studies indicate that high debt in relation to income, wealth or liquid assets is associated with a greater marginal propensity to spend among non-financial corporations and households. One reason cited for this, amongst others, is that balance sheet constraints caused by high debt prevent non-financial corporations and households from implementing their optimum investment and consumption plans. Income changes triggered by monetary policy measures consequently have a stronger impact on investment and consumption than they would in an environment without such balance sheet constraints.

Broader perspective on balance sheet constraints

For quite some time, there has been awareness of and research into the fundamental importance of balance sheet positions for the transmission of monetary policy (the "balance sheet channel"). This literature concentrates on the borrowing capacity of non-financial corporations and households. Recently, this focus has been expanded to include further balance sheet influences, such as liquidity position and debt service capacity. This broader perspective on balance sheet constraints, of which the traditional balance sheet channel is one component, is the subject of analysis in this article. It centres on the question of whether monetary policy measures have a stronger impact when balance sheet constraints play a larger role.

Empirical analysis for the euro area

While the existing empirical studies on this subject mostly look at the United States, this article turns the focus onto the euro area countries. In the following, the article first elaborates on the conceptual foundations for the impact of monetary policy measures being dependent on the debt situation of the non-financial private sector and outlines the results of the existing literature. Then, it presents and discusses econometric estimates for a panel of euro area countries. Finally, based on these estimates, the article evaluates whether the current debt situation in the euro area may tend to amplify the impact of monetary policy impulses.

Conceptual foundations and existing empirical evidence

Impact of monetary policy can be state-dependent

The state-dependent effects of monetary policy have been the subject of investigation in the academic literature for some time now.[1] When monetary policy is described as having "state-dependent effects", this means that its efficacy depends on whether it is expansionary or contractionary as well as on external influences. For example, academic studies show that a tightening of monetary policy has a greater impact than an equivalent degree of monetary policy easing.[2] In addition, monetary policy measures have a weaker impact during recessions than during economic booms.[3]

Balance sheet constraints can lead to state-dependent impact of monetary policy

In the wake of the global financial and economic crisis, there was an increased focus on the balance sheet situations among non-financial corporations and households as a possible cause of monetary policy having an im-

1 Previously, most theoretical and empirical models of monetary policy transmission were based on the assumption that the impact of monetary policy was always qualitatively and quantitatively identical and thus state-independent. For a detailed overview of this literature, see Ramey (2016).
2 See, for example, Morgan (1993), Karras (1996) or Weise (1999). Newer studies such as Angrist et al. (2018) also confirm this result.
3 See, for example, Tenreyro and Thwaites (2016). The authors describe their results with the metaphor "pushing on a string". They also confirm that contractionary shocks have stronger effects than expansionary shocks.

pact that is state-dependent. The fundamental idea is that non-financial corporations and households cannot adjust their investment and consumption decisions completely independently of the prevailing economic circumstances. For example, in times of economic difficulty, non-financial corporations and households with balance sheet constraints are likely to be unable to compensate for all of the temporary income losses triggered by contractionary monetary policy measures by increasing their borrowing. Consequently, they restrict their expenditure more than non-financial corporations and households without balance sheet constraints.

Balance sheet constraints influence monetary policy transmission via income effects in particular

Balance sheet constraints influence monetary policy transmission via direct and indirect income effects in particular. Direct income effects are direct changes in interest expenditure, interest income and other investment income. Monetary policy measures are likely to generate interest income effects primarily among households and non-financial corporations whose balance sheets include large credit liabilities with variable interest rates.[4] For example, if monetary policymakers raise interest rates during an economic upswing in order to dampen inflation, this interest rate hike has a direct impact on the net income of these non-financial corporations and households. Conversely, in an economic downturn, their finances benefit directly from falling short-term interest rates. In addition, indirect income effects triggered by monetary policy also play a role, primarily via changes on the labour market. Individuals with low incomes typically face a higher risk of unemployment. Furthermore, these households often face balance sheet constraints because it is more difficult for them to take out loans than those with higher incomes and lower risks of unemployment. Consequently, they do not borrow funds to compensate for income losses triggered by monetary policy, and monetary policy has a stronger impact.[5]

One important balance sheet constraint affecting loan availability is the existence of loan-to-value ratios. The analysis of these ratios is pivotal to the traditional balance sheet channel of monetary policy transmission,[6] according to which the availability of loans is mostly constrained by the value of collateral (particularly real estate) and the amount of (disposable) income in relation to debt. If debt in relation to this is high and net wealth (assets less liabilities) is thus low, this can give rise to balance sheet constraints that prevent further borrowing. Monetary policy influences these balance sheet constraints, in particular, via its impact on asset prices and income. When expansionary monetary policy measures are taken, rising income and asset prices lead to an easing of balance sheet constraints and make additional borrowing possible. By contrast, contractionary changes in the monetary policy stance increase balance sheet constraints. In both cases, this amplifies the impact of monetary policy measures.[7]

Balance sheet constraints due to loan-to-value ratios

Expansionary monetary policy may have weaker impact than contractionary monetary policy in phases of debt reduction

One extreme case of balance sheet constraints is excessive indebtedness, which prevents further borrowing. In order to ensure long-term sustainability of the debt, borrowers must first refrain from further borrowing or repay their debt. Second, lenders could prevent further borrowing in spite of rising income and asset prices. The effects of expansionary monetary policy measures are thus weaker than those of contractionary monetary policy measures.[8] In line with this, the finance and growth literature shows that high levels of debt have a negative impact on long-term growth (see also the box on p. 18).

Another important balance sheet factor for the degree of monetary policy transmission is the availability of liquid assets, such as cash and

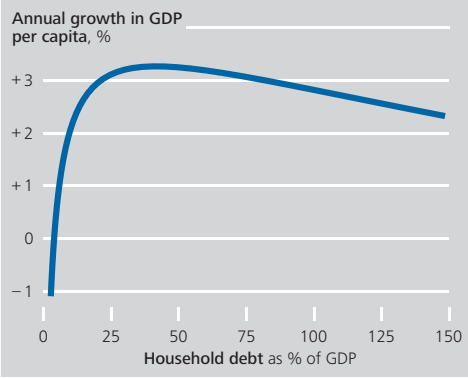
4 See Auclert (2019), Calza, et al. (2013), Di Maggio et al. (2017) and Tzamourani (2021).
5 See Slacalek et al. (2020).
6 See Bernanke et al. (1999).
7 See Guerrieri and Iacoviello (2017).
8 The fundamental idea behind this debt deleveraging dates back to the work of Fisher (1933). Eggertsson and Krugman (2012) were the first to formalise this approach. See Albuquerque (2018), Alpanda and Zubairy (2018) and Alpanda et al. (2019) for empirical evidence.

The impact of debt on long-term economic growth

The main text has thus far focused on the state-dependent effects of the debt situation on the effectiveness of monetary policy. The finance and growth literature examines whether the level of debt also has an impact on long-term equilibrium growth. Specifically, it analyses how financial development affects growth in real gross domestic product (GDP) per capita. The debt ratio, which is also frequently used in the literature on the state-dependent effects of monetary policy, usually serves as a measure of financial development.

One of the first systematic studies in this body of literature was performed by Goldsmith at the end of the 1960s.[1] According to his results, bank assets (as a proxy for debt in the non-financial private sector) relative to GDP correlate positively with economic growth. In the 1990s and 2000s, a number of researchers revisited this subject using econometric methods. The key finding of these works, too, was that a large financing volume has a positive effect on growth.[2]

Non-linear relationship between household debt and economic growth



Source: Unger (2018).
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However, in light of the global financial and economic crisis, the relationship between financing and economic growth has been reevaluated from a variety of angles. In this context, various authors have shown that debt has a state-dependent effect on long-term growth. More precisely, they find that the relationship between the bank loan liabilities of the non-financial private sector as a percentage of GDP and economic growth is non-linear and exhibits an inverted u-shape.[3] Starting from a low level, a rising debt ratio initially has a positive effect on growth up to a saturation point, with subsequent increases in the debt ratio being accompanied by lower growth.

Our own econometric estimates for a panel of 34 advanced economies indicate that, at the sectoral level, an inverted u-shaped relationship can only be found for the household sector.[4] Its debt thus has a state-dependent effect on long-term growth. By contrast, no significant effect on growth can be found for the debt levels of non-financial corporations. The chart below shows the non-linear relationship for households. Here, a rise in the debt ratio up to a level of just under 40% goes hand in hand with perceptibly higher economic growth. Above this level, the relationship turns negative, though the decline in economic growth is comparatively weak. At the current end of the data, the debt ratio in the euro area and Germany exceeds this threshold, at just over 62% and 58% respectively.

1 See Goldsmith (1969).
2 See, for example, King and Levine (1993) or Levine (2005).
3 See, for example, Arcand et al. (2015) or Cecchetti and Kharroubi (2012).
4 The following results are based on Unger (2018). Prior to this, Angeles (2015) and Beck et al. (2012) had already documented differences in the relationship between debt and economic growth for households and non-financial corporations using linear models.

Low availability of liquid assets can also constitute a balance sheet constraint

transferable deposits. The empirical literature shows that "hand-to-mouth" consumers typically have a high marginal propensity to consume.[9] This is because they hold only small amounts of liquid funds. Consequently, a decline in income triggered by monetary policy, for example, cannot be so easily mitigated by using up liquidity buffers. The effects of contractionary monetary policy are thus ultimately reinforced. Through the generally high marginal propensity to consume exhibited by these constrained households, income growth resulting from expansionary monetary policy measures likewise has a greater impact on real economic developments.[10] The reason for the stronger impact is that the previously binding balance sheet constraints meant that households were unable to consume as much as actually envisaged in their optimal consumption plans.[11] Income gains are therefore used relatively extensively for additional private consumption.

Analyses involving microdata confirm that monetary policy measures have greater impact in high-debt regimes …

A number of empirical analyses based on microdata find evidence that monetary policy measures have a stronger impact if balance sheet constraints bind. Findings in the United Kingdom, for example, show that monetary policy is especially potent when a large share of households are financially constrained by high debt ratios.[12] Similarly, an empirical study for the United Kingdom and the United States indicates that, in aggregate terms, the response of consumption to monetary policy shocks is driven by households with mortgage debt. These households possess significant net wealth in the form of real estate. However, due to the fact that they often hold only small amounts of liquid assets, they can cushion temporary income fluctuations to just a limited extent, and changes in income triggered by monetary policy thus have a correspondingly strong impact.[13] Moreover, in the case of Sweden, it is apparent that indebted households exhibit more significant responses to monetary policy shocks than debt-free households. This effect is particularly pronounced in the case of households with variable-rate mortgages.[14] Finally, less mature non-financial corporations in the United Kingdom and the United States make greater adjustments to their investments in response to monetary policy shocks than more mature corporations. According to the study, this is mainly attributable to the fact that less mature non-financial corporations have lower net worth and this limits their capacity to borrow.[15]

… as do a variety of macroeconometric studies

In addition to these microeconometric analyses, a wide variety of macroeconometric studies also investigate whether the effect of monetary policy changes if sectoral debt indicators are at certain levels. For instance, a recent analysis finds that monetary policy shocks in the United States only have a significant impact on real economic activity if households' net wealth is low and, in turn, their borrowing capacity limited. By contrast, during phases of high net wealth – i.e. if balance sheet constraints are non-binding – this study ascertains only minor and also mostly insignificant effects.[16] In addition, a study based on a number of advanced economies concluded that household consumption and investment in residential property respond more strongly to monetary policy shocks in phases of high debt ratios than in periods of low debt.[17] Furthermore, in the United States, monetary policy shocks have a larger impact in times of high loan-to-value ratios (LTVs) than in periods of low LTVs, as households make greater adjustments to their real estate-backed consumer loans.[18]

Balance sheet constraints should amplify impact of monetary policy

All in all, the existing empirical literature thus reinforces the theoretical approach of attributing a greater impact to monetary policy shocks every time economic agents' spending decisions are limited by balance sheet constraints.

9 See Kaplan et al. (2014) and Kaplan and Violante (2018).
10 See Di Maggio et al. (2017) and Flodén et al. (2020).
11 See Kaplan et al. (2014).
12 See Cumming and Hubert (2020).
13 See Cloyne et al. (2020).
14 See Flodén et al. (2020).
15 See Cloyne et al. (2019).
16 See Harding and Klein (2021).
17 See Kim and Lim (2020).
18 See Franz (2019).

This is mainly the case in situations where debt and the associated interest and principal payments are high in relation to income, wealth or liquid assets. In this context, it may be assumed that contractionary shocks also tend to have a more potent effect than expansionary monetary policy interventions if there are balance sheet constraints.

How the impact of monetary policy measures depends on the debt situation in the euro area

Analysis of impact of balance sheet constraints on effectiveness of monetary policy in euro area

As a complement to the existing evidence, this article will now investigate whether balance sheet constraints in the private non-financial sector are linked to changes in the impact of monetary policy in the euro area as well. The analysis is based on a panel of euro area countries. It quantifies how key macroeconomic indicators react to a monetary policy shock depending on the balance sheet conditions. Investment among non-financial corporations and consumption among households are used as dependent variables. For both sectors, the estimates distinguish between two states: balance sheet constraints are highly likely in a high-debt regime and unlikely in a low-debt regime. These estimates examine the effect of balance sheet constraints in isolation and are therefore based on the implicit assumption that expansionary and contractionary shocks have symmetrical impacts.[19]

Information about the balance sheet state derived using levels of various debt indicators

Information about the balance sheet state is derived on the basis of the conceptual considerations outlined above and, in line with the empirical literature, using the levels of various debt indicators. These indicators can be obtained using data from the financial accounts and national accounts. Separate calculations are carried out for both the non-financial corporation and household sectors for each of the individual euro area countries. It should be noted that this analysis discusses the average effects for the respective sector in a given country and cannot show differing reactions between individual households or corporations.

Debt ratio as key indicator for determining balance sheet constraints …

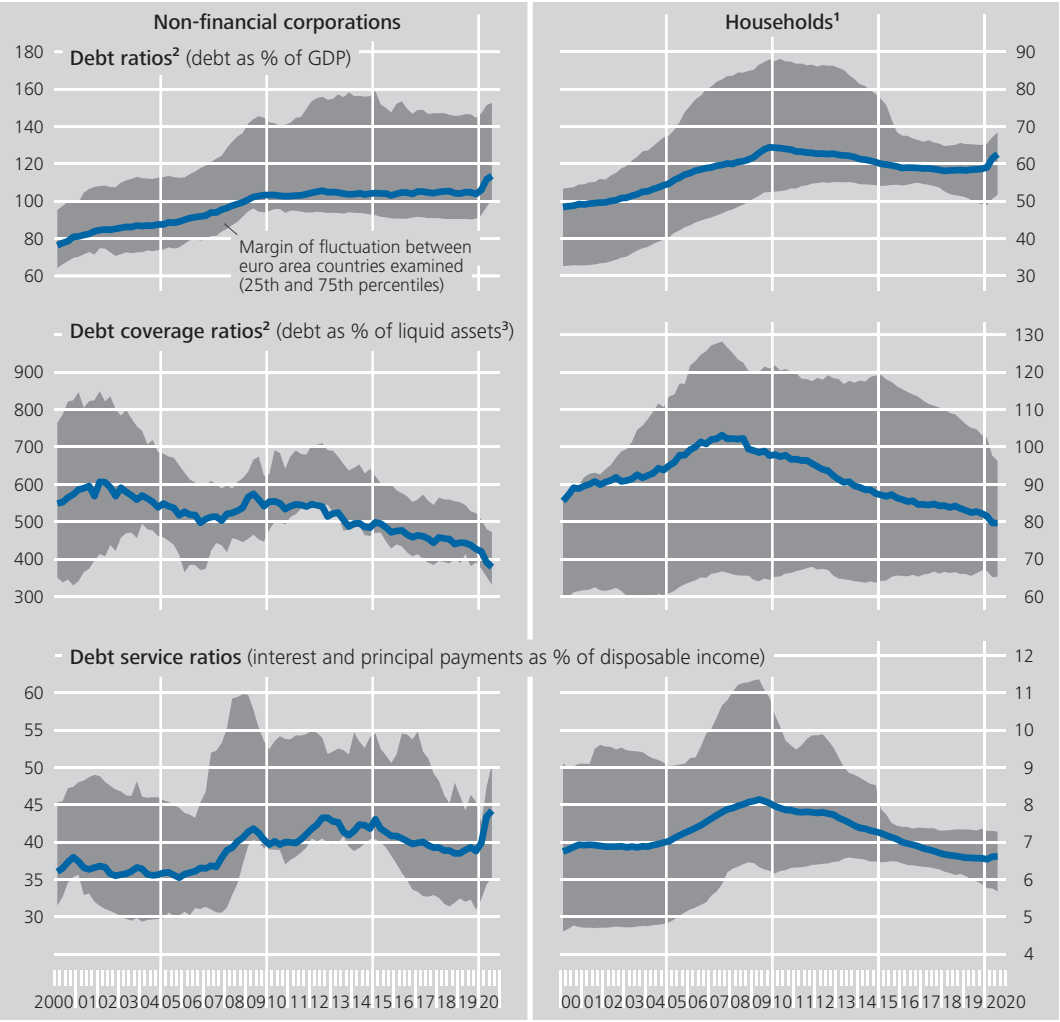
In the empirical literature, the debt ratio has emerged as the key indicator for determining balance sheet constraints. It puts debt in relation to gross domestic product (GDP).[20] For non-financial corporations, debt is calculated as the sum of loans, debt securities, pension provisions as well as trade credits and advances. For households, it is limited to loans. The chart on p. 21 shows the development of the sectoral debt ratios in the euro area as a whole. To illustrate the margin of fluctuation between the euro area countries examined, the range between the 25th and 75th percentiles of the country distribution is additionally shown.

… up sharply since the outbreak of the coronavirus pandemic

The debt ratios of both sectors initially saw steep rises in the 2000s. They then moved sideways for non-financial corporations following the onset of the global financial and economic crisis, while households' debt ratios were on a slight downward path. However, these developments at the euro area level conceal different trends in the individual countries.[21] The private non-financial sectors in Spain and Portugal, for example, reduced their debt ratios significantly, while the upward trend continued in France. The sharp rise over the course of 2020 is largely due to the considerable slump in economic activity as a result of the coronavirus

19 Econometric procedures for implementing two-state dependencies – whether balance sheets are constrained or unconstrained and whether the shock is contractionary or expansionary – are not available at present.
20 In principle, debt could also be put in relation to sectoral income, with the latter reflecting a sector's income situation more closely. GDP is used here, however, to improve comparability with existing studies. As data on the non-financial assets of households and non-financial corporations are often unavailable, the empirical literature mainly uses the debt ratio (debt in relation to income) rather than the leverage ratio (debt in relation to total assets). At the macroeconomic level, the leverage ratio would correspond to the mortgage lending value discussed in theoretical studies (real estate loan relative to real estate assets) at the microeconomic level.
21 For an in-depth analysis of developments in the debt situation of the private non-financial sector in the euro area, see Deutsche Bundesbank (2017).

Debt indicators for the non-financial private sector in the euro area



Sources: ECB and Bundesbank calculations. Sectors and instruments as defined in ESA 2010. **1** Including non-profit institutions serving households. **2** For non-financial corporations, debt is calculated as the sum of loans, debt securities, pension provisions, trade credits and advances. For households, it is limited to loans. **3** Currency and deposits.

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pandemic.[22] Furthermore, debt among non-financial corporations was up significantly.

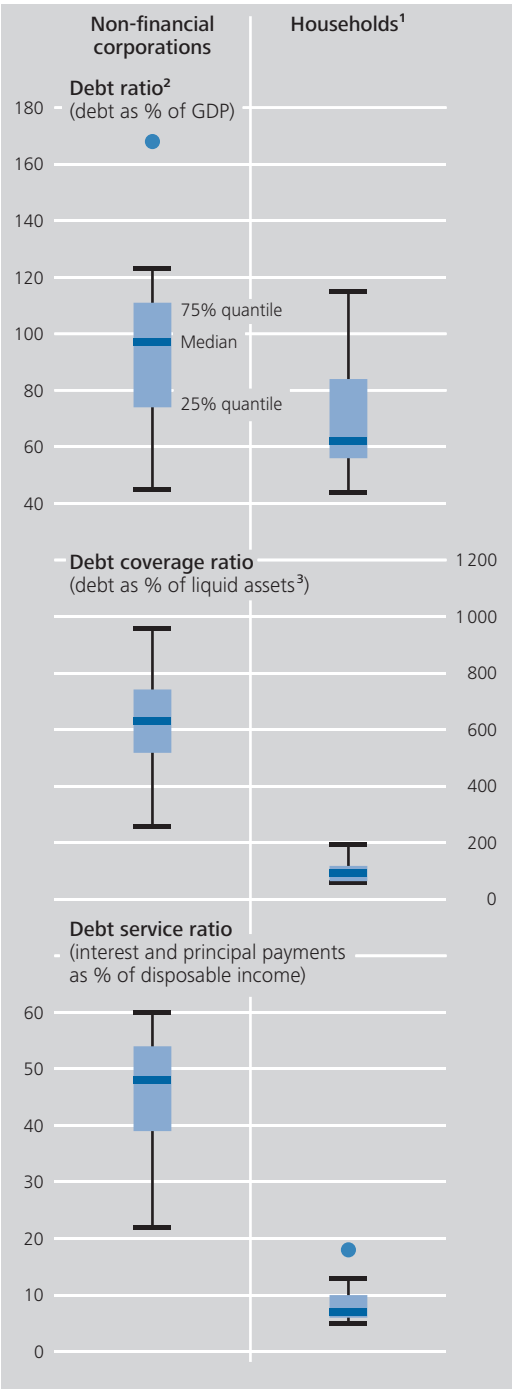
High level of debt relative to liquid assets represents constraint on assets side

The debt ratio only takes constraints on the liabilities side into consideration. However, as explained above, low holdings of liquid assets can also represent a constraint and likewise lead to monetary policy having a state-dependent impact. This is taken into account by the debt coverage ratio, which shows debt in relation to liquid financial assets, measured here as currency and deposits. The above chart illustrates the development of this ratio. This indicator has fallen in both parts of the non-financial private sector since the global financial and economic crisis, driven in particular by a rise in liquid assets. The renewed acceleration in the decline since the outbreak of the coronavirus pandemic, especially among non-financial corporations, is likely to be attributable in part to the copious liquidity assistance from the public sector.

The debt service ratio is another indicator of balance sheet constraints. It shows interest and

22 Owing to government support measures, the decline in the sectoral income of households was distinctly smaller than that of GDP, whereas there was a significantly sharper decrease in the sectoral income of non-financial corporations.

Country-specific thresholds for identifying debt-induced balance sheet constraints*



Sources: ECB and Bundesbank calculations. Sectors and instruments as defined in ESA 2010. * The boxplots show the distribution of the country-specific and sector-specific thresholds. The blue line indicates the median, the upper and lower edges of the box mark the quartiles. The whiskers each extend to the outermost data point that is within 1.5 times the interquartile range (size of the box) from the edges of the box. Outliers are plotted as dots. **1** Including non-profit institutions serving households. **2** For non-financial corporations, debt is calculated as the sum of loans, debt securities, pension provisions, trade credits and advances. For households, it is limited to loans. **3** Currency and deposits.

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Debt service ratio as further indicator of short-term balance sheet constraints

principal payments in relation to disposable income. The monetary policy stance has a significant influence on interest rates and thereby a knock-on effect on interest expenditure.[23] The chart on p. 21 shows developments in the debt service ratios.[24] Particularly for households, it has been falling continuously since 2008, mainly due to lower interest payments. For non-financial corporations, it has been moving sideways with some fluctuation since the global financial and economic crisis. Taken in isolation, the falling interest rate level provided relief in this regard, but growing debt levels counteracted this development. With the onset of the coronavirus crisis, the debt service ratio among non-financial corporations rose perceptibly on the back of the sharp fall in sectoral income.

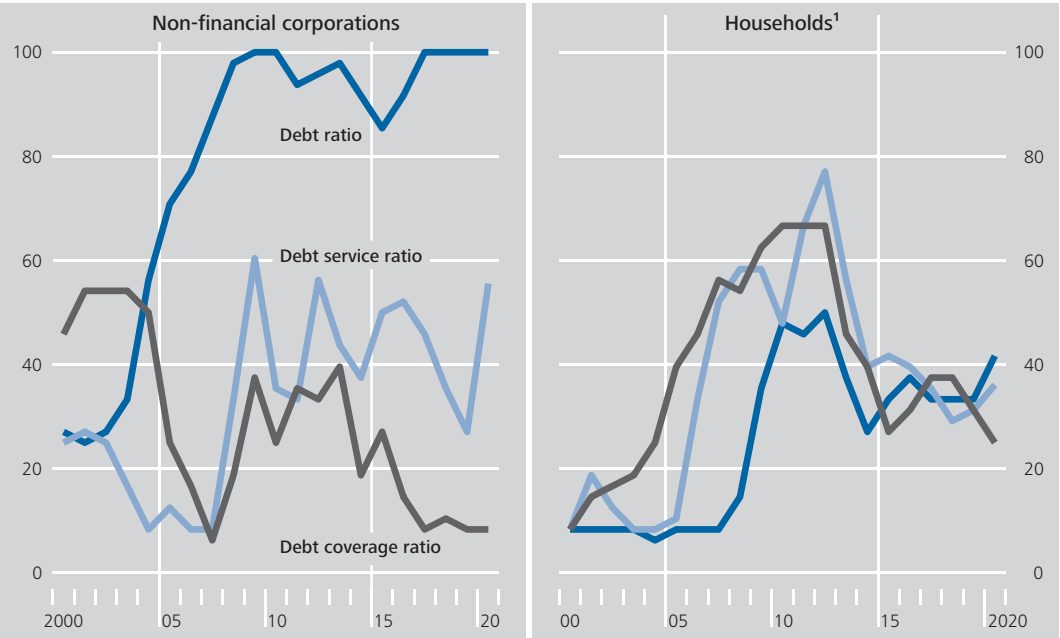
Categorisation as high-debt and low-debt regimes based on debt indicators

For the indicators described above, it is possible to derive thresholds that can be used to estimate the state-dependent impact of a monetary policy shock.[25] If the value of an indicator exceeds the threshold, a sector is in a high-debt regime. Values below the threshold indicate that the sector is in a low-debt regime. The individual euro area countries are subdivided by sector into non-financial corporations and households. Specifically, the thresholds are determined based on a specific percentile chosen to maximise the explanatory power of the panel estimation methods used for this analysis. In addition, this percentile ensures that the state-dependent effects documented in the literature are reflected in the responses of real

23 For an in-depth analysis of the impact of monetary policy shocks on developments in the debt service ratio for the non-financial private sector in the euro area, see Deutsche Bundesbank (2019).
24 The sectoral debt service ratios are calculated in line with the methodological requirements set out by the Bank for International Settlements. For more information, see Drehmann et al. (2015).
25 See, for example, Alpanda and Zubairy (2018), Alpanda et al. (2019), Franz (2019) and Klein and Harding (2021).

Share of countries in which non-financial corporations and households face debt-induced balance sheet constraints*

%



Sources: ECB and Bundesbank calculations. Sectors as defined in ESA 2010. * This chart shows the share of countries in which, at a given point in time, non-financial corporations or households faced balance sheet constraints. Classification is based on country-specific thresholds. If the value of an indicator is above the threshold, the sector is considered to be experiencing balance sheet constraints; otherwise, the sector is not considered to be experiencing balance sheet constraints. The individual euro area countries are subdivided by sector. 1 Including non-profit institutions serving households.

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variables.[26] The sectoral percentile calculated in this manner for the panel dataset as a whole is then individually applied to each country, generating country-specific thresholds for the three indicators. This addresses, in particular, structural differences between the individual countries in the level of the indicators, while at the same time assuring that a certain margin of distribution is identified as a high-debt regime across countries.[27] The threshold for the household debt ratio for each of the countries in this sample is set, for instance, at the 76th percentile.

Using percentiles to derive country-specific thresholds

The chart on p. 22 shows the distribution of the country-specific thresholds that categorise a country's non-financial corporations and households as being in a high-debt or low-debt state. It shows that, for the debt ratio among households, most of the thresholds are located around the 65% mark. For non-financial corporations, the median threshold is around 97%. The country-specific thresholds for the debt service ratio and the debt coverage ratio are considerably higher for non-financial corporations than for households. In the case of the debt service ratio, this is due, in particular, to non-financial corporations' lower sectoral income. As regards the debt coverage ratio, the small stocks of liquid assets by sectoral standards are the reason for the higher thresholds.

The above chart shows the percentage share of countries in which non-financial corporations

26 The threshold values are calculated largely following Cecchetti et al. (2011). The authors look at the non-linear relationship between long-term growth and debt, and, in this context, determine a critical value which is identical for all observed countries. Debt in excess of this threshold is associated with lower growth. When determining the threshold, the authors ensure that it minimises the sum of squared residuals of the underlying estimated model. By contrast, in this analysis, the thresholds are determined specifically for each country in order to address structural differences between the individual countries. In addition, a constraint is imposed: that the calculated thresholds are consistent with the state-dependent responses documented in the literature.

27 Due to the limited number of observations, it is impossible to estimate country-specific percentiles.

Empirical approach to quantifying state-dependent effects of monetary policy shocks on real economic indicators

Measuring the causal influence of monetary policy on macroeconomic indicators such as investment and consumption requires identification of exogenous changes in the monetary policy stance. These are defined as changes that were not expected by market participants, referred to as monetary policy shocks, and are distinct from changes in the monetary policy stance in response to past, present or expected developments. Only in the first case can the impact of monetary policy measures on macroeconomic indicators be disentangled from other influencing factors. In the second case, the cause would instead lie in the changing economic setting, to which monetary policy systematically responds within the framework of its monetary policy reaction function.

Monetary policy shocks are identified using high-frequency financial market data.[1] This involves measuring changes in market rates surrounding what is known as an event window.[2] Specifically, this analysis looks at the period from shortly before publication of the press release on monetary policy decisions to just after the press conference following the meetings of the ECB Governing Council. This is in line with the approach taken by Altavilla et al. (2019). The identification assumption is that all interest rate changes occurring within this selected event window are attributable to unexpected announcements of monetary policy measures. These interest rate changes are then used as external instruments in an econometric estimation in order to identify the changes in the monetary policy stance resulting from an exogenous monetary policy shock. The shadow short rate of Geiger and Schupp (2018) serves as a composite indicator of the monetary policy stance. Since the shadow rate combines information on short-term and long-term interest rate movements, it responds to both standard and non-standard monetary policy measures, provided these are reflected in the yield curve. This allows for account to be taken of the fact that the non-standard monetary policy measures implemented in recent years impacted the long end of the yield curve in particular.

In concrete terms, the influence of monetary policy on real economic indicators is estimated using local projections as propounded by Jordà (2005) with instrumental variables (LP-IV) for a panel dataset.[3] In the first step, the shadow rate is regressed on the previously identified monetary policy shocks.[4] The estimation results are then used to calculate predicted values for the shadow rate.[5] These predictions depict the changes in the shadow rate that can be ascribed purely to monetary policy shocks. The second step uses these predictions to construct what are known as local projections for the real economic indicators. This involves estimating a series of equations in which the macroeconomic indicator is regressed on the estimated shadow rate values.[6] These equations are estimated for different lags of the shadow rate in comparison with the dependent variables. The function of the shadow rate's regression coefficients for

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1 See Gürkaynak et al. (2005) and Gertler and Karadi (2015).
2 The reference dataset for this is the Euro Area Monetary Policy Event-Study Database. For more information, see Altavilla et al. (2019).
3 For more information on local projections with instrumental variables (LP-IV) for panel data, see, for example, Jordà et al. (2015, 2019).
4 The shock time series is identified analogously to the split-sample method of Swanson (2021). Up to the end of 2012, unexpected changes in the one-year OIS rate around the time of monetary policy meetings are defined as monetary policy shocks. From 2013 onwards, however, reference is made to unexpected changes in the ten-year OIS rate. This accounts for the non-standard monetary policy measures, which affect the long end of the yield curve in particular. For a similar approach, see, for example, Tillmann (2020). The interest rate changes are drawn from the database of Altavilla et al. (2019).
5 The F-statistics of the estimations in the first step are each above their respective critical values. The null hypothesis of weak instruments can thus be rejected.
6 For non-financial corporations, investment was used. For households, consumption was used. Both variables were standardised using gross domestic product (GDP).

each lag estimated in this way then corresponds to the response of the macroeconomic indicator to the monetary policy shock over the response horizon in question. It can be interpreted as the impulse-response function of the dependent variable to the monetary policy shock. Separate estimations are carried out for non-financial corporations and households. Combined, this results in the following estimation equations:

1. First regression step: Estimation of instrumental variables

$$ssr_t = \mu + \varphi inst_t + \omega(L)x_{i,t} + \eta_t.$$

Here, ssr is the shadow short rate, μ is a constant, $inst$ is the high-frequency change in the market rate interpreted as a response to the exogenous monetary policy shock, x is a vector with control variables,[7] and η is an error term. In addition, i represents a country index and t represents a time index. This estimation equation is used to generate predicted values for $\widehat{ssr}$, which are then input into the estimation equations of the second regression step.

2.a Second regression step: Impact of monetary policy on investment and consumption without taking account of the balance sheet state[8]

$$y_{i,t+h} - y_{i,t-1} = \alpha_{i,h} + \beta_h \widehat{ssr}_t + \gamma_h(L)x_{i,t} + \varepsilon_{i,t+h}.$$

Here, y is the macroeconomic indicator – investment for non-financial corporations or consumption for households – α is a country-specific constant, $\widehat{ssr}$ is the predicted value for the shadow rate from the first regression step, x is the vector with control variables used previously, ε is an error term, i is the country index and t is the time index. The variable h can take a value of between 0 and 16. The estimated parameter β_h is the cumulative change at time $t+h$. This yields a local projection spanning a period of 16 quarters. As, by construction, the error terms can be autocorrelated, Driscoll-Kraay standard errors are used. The estimation period extends from the beginning of 1999 to the end of 2019. The period since the outbreak of the coronavirus pandemic is thus excluded in order to avoid biasing the estimations. The shock is normalised to an unexpected reduction in the shadow rate of 100 basis points. In order obtain state-dependent impulse responses, the second-step equation is also estimated as follows:

2.b Second regression step: Impact of monetary policy on investment and consumption taking account of the balance sheet state[9]

$$\begin{aligned} y_{i,t+h} - y_{i,t-1} = {} & I_{i,t-1}\left[\alpha_{B,i,h} + \beta_{B,h}\widehat{ssr}_t \right. \\ & \left. + \gamma_{B,h}(L)x_{i,t}\right] + (1 - I_{i,t-1}) \\ & [\alpha_{U,i,h} + \beta_{U,h}\widehat{ssr}_t \\ & + \gamma_{U,h}(L)x_{i,t}] + \varepsilon_{i,t+h}. \end{aligned}$$

Here, $I_{i,t-1}$ denotes the balance sheet state of non-financial corporations or households prior to the monetary policy shock. The indicator takes a value of one if the debt indicators of non-financial corporations or households in country i are above the threshold and a value of zero if they are below the threshold. The estimated parameters $\beta_{B,h}$ and $\beta_{U,h}$ thus depict, respectively, the response of a sector experiencing balance sheet constraints and a sector not experiencing balance sheet constraints at time h. As explained in the main text, non-financial corporations and households are categorised as balance sheet constrained or balance sheet unconstrained on the basis of the three debt indicators.

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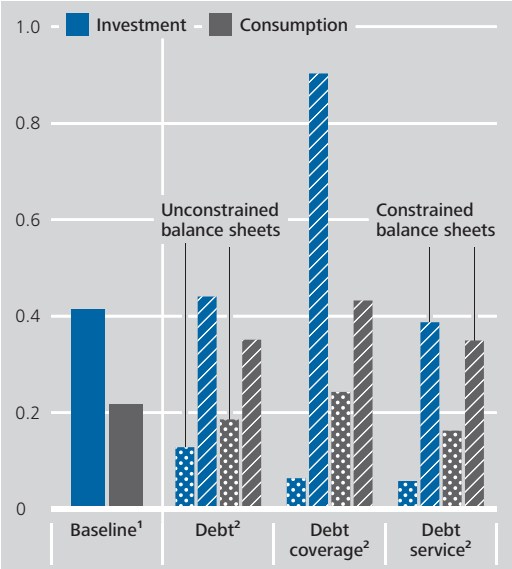
7 Specifically, the following control variables are included: real GDP growth, inflation rate, growth in real house prices, and lagged values of the dependent variables. The lag length is $q=1$.
8 So that the estimation uncertainty of the first step is accounted for in the second step, the sum of the squared errors is automatically corrected accordingly.
9 For more information on using local projections to identify asymmetrical effects, see, for example, Auerbach and Gorodnichenko (2013), Jordà et al. (2019) and Owyang et al. (2013).

State-dependent responses to an expansionary monetary policy shock

Average effect in percentage points over 12 quarters



Sources: ECB and Bundesbank calculations based on local projections following Jordà et al. (2015, 2019). Sectors and instruments as defined in ESA 2010. **1** The baseline model does not take account of debt-induced balance sheet constraints. **2** "Debt", "Debt coverage" and "Debt service" each refer to the estimation model in which the respective ratio was used as the indicator for differentiating sectors with debt-induced balance sheet constraints from those without such constraints.

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High debt particularly around time of global financial crisis

or households were in a high-debt regime at a given point in time. It shows that, especially in the period bookending the global financial and economic crisis, non-financial corporations and households were in a high-debt regime in a considerably larger number of countries. While the low interest rate environment has prevailed for several years now, the debt situation has eased perceptibly again, especially among households.

Estimating the state-dependent impact of monetary policy shocks using local projections

The thresholds can be employed to show the state dependence of the impact of a monetary policy shock on the basis of impulse responses, which are calculated in a panel context using local projections.[28] The impulse responses show how household consumption and non-financial corporations' investment respond to an expansionary monetary policy shock, depending on the debt regime. The magnitude of the monetary policy shock is normalised to a decline in the shadow short rate of 100 basis points.[29] For purposes of comparison, the responses are also shown without differentiation by debt regime. The models were estimated separately for each of the two sectors and three debt indicators. The box on pp. 24 f. provides a detailed description of the econometric approach used. The adjacent chart presents the results of the estimations. To provide a clearer overview, the chart shows the average effects over 12 quarters instead of the full impulse responses.

Stronger responses to monetary policy shocks in high-debt regimes …

The baseline model does not make a distinction between the high-debt and low-debt states and produces the expected results: non-financial corporations and households respond to an expansionary monetary policy shock by increasing, respectively, their investment and consumption. Conditional on the debt regime, the results vary perceptibly: in a high-debt environment, non-financial corporations and households increase their spending to a considerably stronger degree in response to an expansionary monetary policy shock than in a low-debt regime.[30] These differences are significantly more pronounced for non-financial corporations than for households.

… especially where non-financial corporations have a high debt coverage ratio

The effects among households are quite similar across all three indicators. As regards non-financial corporations, the response of investment depends particularly heavily on whether the debt coverage ratio is high or not. This suggests that short-term liquidity bottlenecks, in particular, could represent a balance sheet constraint for non-financial corporations. To sum up, monetary policy shocks in phases in which

28 The estimation period of the panel dataset ranges from the beginning of 1999 to the end of 2019 and comprises the following countries: Austria (AT), Belgium (BE), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), Luxembourg (LU), the Netherlands (NL) and Portugal (PT). For more information on using local projections to identify state-dependent effects, see, for example, Auerbach and Gorodnichenko (2013), Jordà et al. (2019) and Owyang et al. (2013). For more information on calculating local projections with instrument variables in a panel dataset, see, for example, Jordà et al. (2015, 2019).
29 The shadow rate used here is based on the model specification of Geiger and Schupp (2018).
30 The impulse responses are significantly different from one another for a 68% confidence interval.

Debt-induced balance sheet constraints in the euro area countries*

% deviation from threshold, as at Q3 2020

Sources: ECB and Bundesbank calculations. Sectors as defined in ESA 2010. * This chart shows the current percentage deviations of the three debt indicators from the respective sectoral threshold for the euro area countries. Observations above the horizontal zero line indicate balance sheet constraints for non-financial corporations. Similarly, values to the right of the vertical zero line indicate possible balance sheet constraints for households. **1** Including non-profit institutions serving households.

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the debt indicators are above the thresholds are associated with visibly stronger responses of real economic variables.

Conclusions and outlook

Impact of monetary policy shocks is stronger if debt is high

As a result of the economic restrictions due to the coronavirus pandemic, the debt situation in the non-financial private sector in the euro area as a whole and its individual member countries has seen a trend deterioration. This is reflected, above all, in a rise in the debt-to-income ratio among non-financial corporations and households. Against this backdrop, this article investigated whether the debt situation in the non-financial private sector could potentially affect the transmission of monetary policy. It found that monetary policy shocks always have a relatively strong impact in those cases where non-financial corporations or households are highly indebted. This result holds irrespective of which of the three debt indicators used here is applied.

Current debt situation could impact on effectiveness of monetary policy in the euro area

This article concludes by seeking to establish, based on the estimation results presented above, the extent to which the current debt situation could potentially impact the effectiveness of monetary policy in the euro area as things now stand. To this end, the above chart presents the deviations of the current values of the three debt indicators from the respective thresholds for the individual euro area countries. Observations above the horizontal zero axis indicate that non-financial corporations are highly indebted. Similarly, values to the right of the vertical zero axis indicate that households are highly indebted.

Non-financial corporations and households mostly not in high-debt regimes

For non-financial corporations, the debt ratio indicates a high-debt regime in all countries. By contrast, the debt service ratio points to a high-debt regime only in around one-half of all cases and the debt coverage ratio in only one case. One reason for the discrepancy between the indicators is that non-financial corporations (collectively) have relatively large liquidity buf-

fers. Another is that the low level of interest rates, in and of itself, has provided relief with regard to debt service. For households, the majority of the indicator levels do not appear to suggest high-debt regimes as defined in the empirical analysis explained above. This is especially true of the debt coverage ratio.

All in all, it thus cannot be ruled out that, at the current end, the debt situation is amplifying the impact of monetary policy shocks in a small number of countries and sectors. However, despite the pandemic-induced deterioration in the debt situation, widespread balance sheet constraints which could amplify the impact of monetary policy are currently nowhere to be seen. At present, the debt situation is therefore not set to contribute to any significant amplification of the impact of monetary policy measures.

Debt situation currently not expected to have a strong impact

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