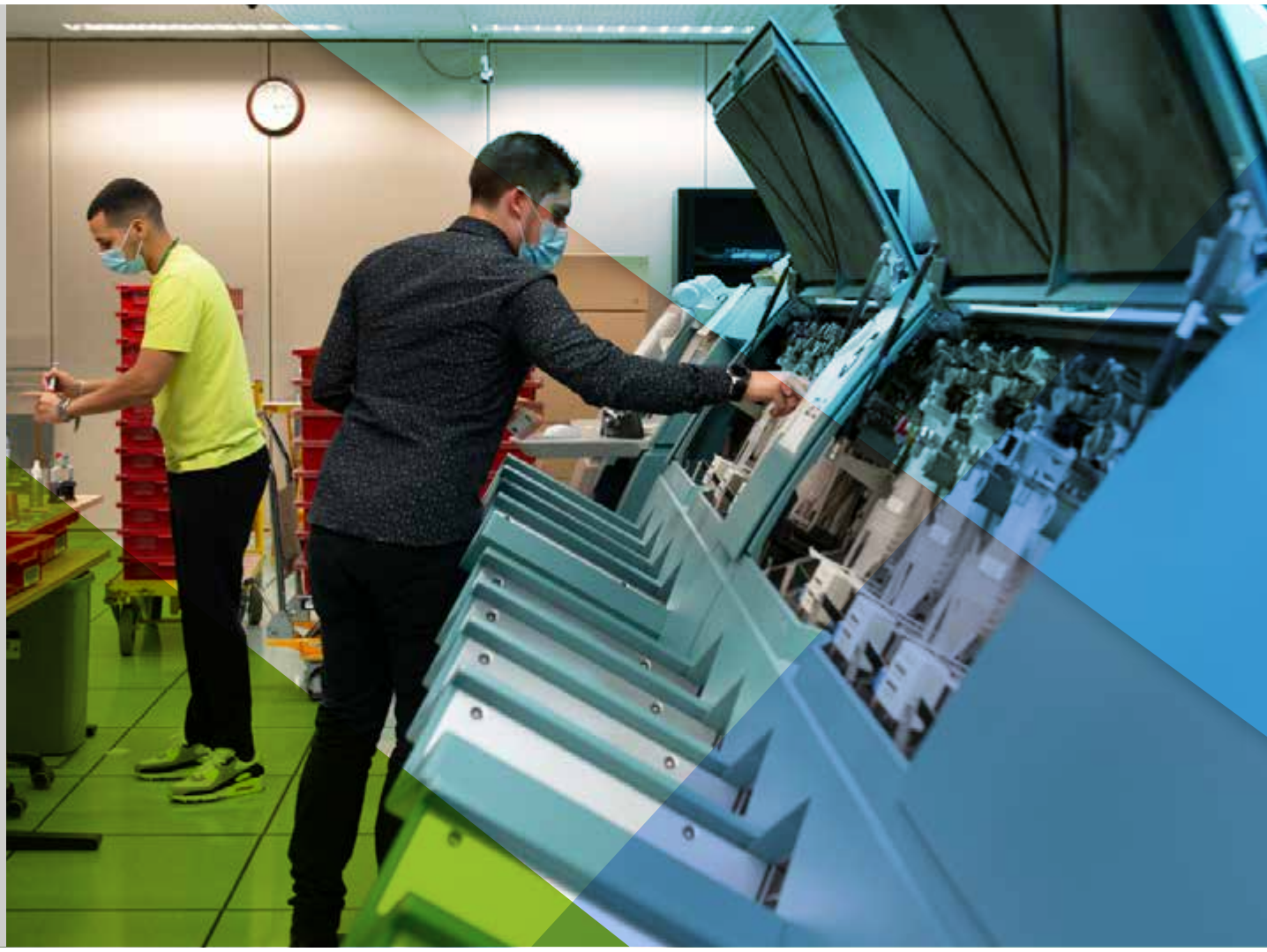
ECONOMIC REVIEW
June 2021



National Bank OF BELGIUM
Eurosystem

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Contents

Economic projections for Belgium – June 2021

- The swift roll-out of the vaccination campaigns implies that an effective medical solution for COVID-19 is now within reach, i.e. much earlier than what had to be assumed in the previous projections.
- Against this backdrop the remaining containment measures are gradually being loosened and further steps towards a full reopening of the economy have been announced.
- Belgian GDP growth surprised on the upside and outpaced that in the euro area in the last two quarters. It should gain further traction and shift to a higher gear in the summer. The pre-crisis level will already be reached again by the end of this year.
- Business investment has already made up for a large part of its loss in 2020, but will continue to support growth as its underlying fundamentals remain favourable.
- As more activities become possible again, private consumption will be the main growth engine, even without using the accumulated savings from 2020 for "revenge spending".
- The impact of the pandemic on the labour market remains limited, but some further labour-shedding is expected when income support systems disappear.
- Headline inflation shoots up this year, mainly due to higher energy prices. Core inflation is drifting upwards as well due to price pressures as economies reopen, supply constraints and businesses looking to restore profit margins but it should peak by mid-2022.
- Wage costs are projected to rise quite rapidly in the coming years, mostly fuelled by the indexation mechanisms.
- The budget deficit is expected to come down only gradually in the next few years and, with normal economic growth, government debt remains on an upward path, also after the end of the projection period.
- The risks surrounding the outlook remain high and dependent on the health situation and the timeline and effectiveness of implementation of the vaccination campaigns.
- As usual, the projections only take into account government measures that have been decided and are likely to pass the legislative process and had been announced in sufficient detail by the cut-off date (26 May 2021). Additional government measures could affect the growth outlook as well as the public finance projections.

Introduction

The macroeconomic projections for Belgium described in this article are part of the joint Eurosystem projections for the euro area. That projection exercise is based on a set of technical assumptions and forecasts for the international environment drawn up jointly by the participating institutions, namely the ECB and the national central banks of the euro area. The cut-off date for the Belgian projections was 26 May 2021. The baseline projections for Belgium are discussed in detail. While the Eurosystem has also developed two risk scenarios for the euro area (one better and one worse than the baseline), no such scenarios for Belgium are presented here as they may not give a fully accurate picture of the remaining uncertainty around the baseline projections. Instead, individual risks are discussed in the final section of this article.

1. The world economy is bouncing back strongly from the COVID-19 crisis

The COVID-19 pandemic and especially the exceptional containment measures taken by many countries to limit the spread of the virus have profoundly affected the world economy in the first half of last year. On average, global activity (excluding the euro area) shrank by 2.4 % in 2020. At the same time, the second half of the year saw a strong rebound and, by the end of 2020, the global economy was already back to its pre-pandemic level, even though this can mostly be traced back to the exceptionally strong recovery in China. Elsewhere, and in the advanced countries in particular, the economy needs more time to fully get back on its feet. However, the economic damage of the second and third COVID waves since the autumn of last year has generally been much more limited than in the spring. The recovery was delayed, but not derailed. This is partly due to learning effects : while the first COVID wave took the world by surprise and full lockdowns were the initial policy answers, economic agents have gradually learned to live with the disease in the later stages of the pandemic. In that connection, the restrictions have often led to a more rapid development of digitalisation.

This spring, the number of infections and hospitalisations flared up again and the pandemic is still wreaking havoc in certain emerging market economies, such as India. At the same time, vaccination campaigns have progressed well in the advanced countries and most containment measures are gradually lifted, even before vaccination numbers reach the estimated level of herd immunity. This implies that an effective medical solution to the pandemic is now within reach, faster than anybody imagined and faster than what had to be assumed in the previous Eurosystem projections. This is the main reason, in addition to the aforementioned learning effects in the later stages of the pandemic, why the economic outlook has been revised upwards significantly. According to the current Eurosystem assumptions, global activity is projected to rebound sharply by 6.2 % in 2021 and to increase by 4 % on average in 2022 and 2023.

Global trade remained relatively resilient last year. Global real imports (excluding the euro area) dropped by 8.5 % in 2020, i.e. by less than in 2009, even though overall economic activity declined more strongly last year than during the financial crisis. This may be due to the fact that containment measures were especially oriented towards the less trade-intensive services industry. According to the Eurosystem assumptions, global trade (excluding the euro area) is projected to increase by nearly 11 % in 2021 and trade will regain its pre-crisis level by mid-2021 already. However, new risks come to the fore. As demand is recovering faster than supply, the global trade and output outlook could be temporarily threatened by supply-side constraints and shortages of intermediate inputs, as illustrated by the lengthening delivery times and upward pressure on commodity prices.

Table 1

The international environment

(annual percentage changes)

	2019	2020	2021 e	2022 e	2023 e
World (excluding euro area) real GDP	2.9	–2.4	6.2	4.2	3.7
World (excluding euro area) trade	–0.1	–8.5	10.8	4.9	3.7
Euro area foreign demand [1]	0.8	–10.0	8.6	5.2	3.4
Belgium's relevant export markets [1]	2.1	–9.8	8.5	6.4	3.5

Source : Eurosystem.
1 Calculated as a weighted average of imports of trading partners.

As usual, the profile of world trade determines the growth path of euro area foreign demand and Belgian export markets, with the latter being an important element for the macroeconomic projections for Belgium in

the medium term. Compared to the NBB's December 2020 projections, Belgian export market figures have been revised upwards, reflecting an improved outlook in some of our trading partners.

Turning to the technical and financial assumptions underlying these new Eurosystem projections, the exchange rate is considered to remain constant throughout the projection period. In the case of the US dollar, this implies an exchange rate of $ 1.21 to the euro, i.e. a clear appreciation of the euro compared to the average level in 2019 and 2020.

As usual, oil price and interest rate assumptions are based on market expectations of mid-May 2021. The price per barrel of Brent crude oil had reached $ 68 in the second quarter of 2021 and is expected to remain at that level until the end of the year, before dropping gradually as of next year, reaching just over $ 60 by the end of the projection period. The three-month interbank deposit rate is expected to rise only very mildly, from an average of –0.5 % in 2021 to –0.3 % in 2023. The Belgian sovereign long-term interest rate has recently turned slightly positive again and is expected to continue to rise gradually to 0.6 % in 2023. This should lead to an increase in the average mortgage interest rate over the projection horizon, although it should remain favourable and should not exceed 2 %. The average interest rate on business loans should also edge up only a little in the next few years.

As regards the mechanical impact on economic activity, the stronger outlook for export markets is likely to more than offset the higher oil price and interest rates. Hence, the new set of Eurosystem assumptions in principle accounts for an upward revision of the projections.

Table 2

The Eurosystem technical assumptions

(annual averages; in %, unless otherwise stated)

	2019	2020	2021 e	2022 e	2023 e
EUR/USD exchange rate	1.12	1.14	1.21	1.21	1.21
Oil price (US dollars per barrel)	64	42	66	65	62
Interest rate on three-month interbank deposits in euro	–0.4	–0.4	–0.5	–0.5	–0.3
Yield on ten-year Belgian government bonds	0.2	–0.1	0.1	0.4	0.6
Business loan interest rate	1.5	1.6	1.6	1.6	1.7
Household mortgage interest rate	1.8	1.6	1.5	1.7	1.8

Source: Eurosystem.

2. Activity in the euro area should rebound strongly

The euro area economy has posted a strong recovery in the summer of 2020 but the resurgence of the pandemic and the various containment measures since the fall have led to minor contractions in the last two quarters. However, the strong improvement in the short-term indicators point to a rebound in the second quarter of 2021. More generally, the successful roll-out of the vaccination campaigns allows for a gradual loosening of the containment measures. Based on the current information and policy announcements, the full reopening of the economy should come much faster than assumed in the previous Eurosystem projections. The baseline scenario now assumes a full phasing-out of containment measures by early-2022. At the same time, the current supply bottlenecks should not be a persistent impediment to growth. Against that background and in line with

the ongoing recovery in foreign demand, the economic outlook for the euro area has been revised upwards significantly in the current projections.

In the baseline scenario euro area activity should accelerate strongly as of the second half of the year, driven by a sharp rebound in private consumption. This allows real GDP to exceed its pre-crisis level from the first quarter of 2022, one quarter earlier than previously projected. This does not only reflect a smaller economic impact of the pandemic given the progress in the vaccination campaign, but also substantial additional fiscal policy measures – including, in part, Next Generation EU funds – and an upgrade to the outlook for foreign demand, in part due to the inclusion of recently approved and announced fiscal policy packages in the US into the baseline. All in all, the euro area economy should expand strongly by about 11.5 % in the 2021-2023 period and stand 4.7 % above its pre-crisis level with a positive output gap. Domestic demand, and in particular private consumption, is expected to drive most of the rebound.

Inflation was very low in 2020 but has edged upwards in recent months, with the upswing mostly driven by energy prices. It is expected to peak at 1.9 % in 2021, close to target. However, this inflation spike is largely driven by strong base effects as well as specific factors, such as the reversal of the German VAT rate and rising input prices and transportation costs due to supply bottlenecks, which are considered temporary. The uptick in inflation should not be persistent : as these temporary factors will gradually fade, headline inflation is expected to drop back to about 1.5 %, in the latter two years of the projection horizon. Core inflation edges up gradually to 1.4 % in 2023.

Risks to growth are seen as balanced over the projection horizon. Less favourable medical developments (e.g. related to virus mutations or vaccine acceptance), as well as disruptions from a wave of bankruptcies could further delay a full recovery. At the same time, a stronger surge in private consumption following a steeper decline in the saving ratio due to more important revenge consumption effects may boost domestic demand more. Risks to inflation, for the current year in particular seem to be tilted to the upside and mostly pertain to the surge in input costs and its impact on consumer prices.

Table 3

Eurosystem projections for the euro area

(percentage changes compared to the previous year, unless otherwise stated)

	2019	2020	2021 e	2022 e	2023 e
Real GDP	1.3	–6.8	4.6	4.7	2.1
of which (contributions in percentage points) :					
Domestic demand (excluding changes in inventories)	2.3	–5.8	3.8	4.6	1.9
Net exports	–0.5	–0.6	0.7	0.0	0.2
Inflation (HICP)	1.2	0.3	1.9	1.5	1.4
Core inflation [1]	1.0	0.7	1.1	1.3	1.4
Domestic employment	1.2	–1.6	0.3	1.2	1.0
Unemployment rate [2]	7.5	7.8	8.2	7.9	7.4
General government financing requirement (–) or capacity [3]	–0.6	–7.3	–7.1	–3.4	–2.6
Public debt [3]	83.9	98.0	99.4	96.3	95.2

Source : ECB.

1 Measured by the HICP excluding food and energy.

2 In % of the labour force.

3 In % of GDP.

Massive government support measures and the short-time working schemes in particular have cushioned the blow of the crisis on the labour market. Employment is projected to recover gradually over the projection horizon and reach its pre-crisis level around the beginning of 2023, lagging about one year with respect to real GDP. The projected increase in the unemployment rate remains limited as the withdrawal of job retention schemes is expected to be compensated by the post-pandemic recovery. In annual terms, unemployment should be below its pre-crisis level by 2023.

The euro area budget deficit still remains high in 2021 but drops in the outer years of the projection period, as the government support measures are gradually phased out. The government debt ratio peaks at just below 100 % this year but the decline in the deficit puts it back on a declining path thereafter, also when economic growth normalises.

3. The Belgian economy continues to gain traction and should shift to a higher gear in the summer

Since the number of COVID-19 infections and hospitalisations flared up again in the autumn of last year, nationwide containment measures were reintroduced that affected, at least temporarily, bars and restaurants, non-essential shops, non-medical contact professions, schools and many leisure activities. It had already been anticipated in the NBB December projections that these new restrictions would have a more limited direct impact on economic activity. First, the construction and manufacturing industries have mostly remained fully operational. Second, businesses in the trade and services industry seem to have been somewhat better prepared than in the spring to offset some of the restrictions on brick-and-mortar shops via e-commerce, take-away concepts and sales by appointment. In the end, growth has exceeded our short-term projections according to the current quarterly statistics: economic activity remained roughly flat in the last quarter of 2020 and it was up by 1 % in the first quarter of this year (this figure having been revised upwards significantly from the first NAI flash estimate). According to these quarterly statistics, economic activity was clearly more resilient in Belgium than elsewhere in the euro area after the summer of 2020. All in all, this has left Belgian GDP at a level that is only some 4 % below the pre-pandemic level by the beginning of spring 2021.

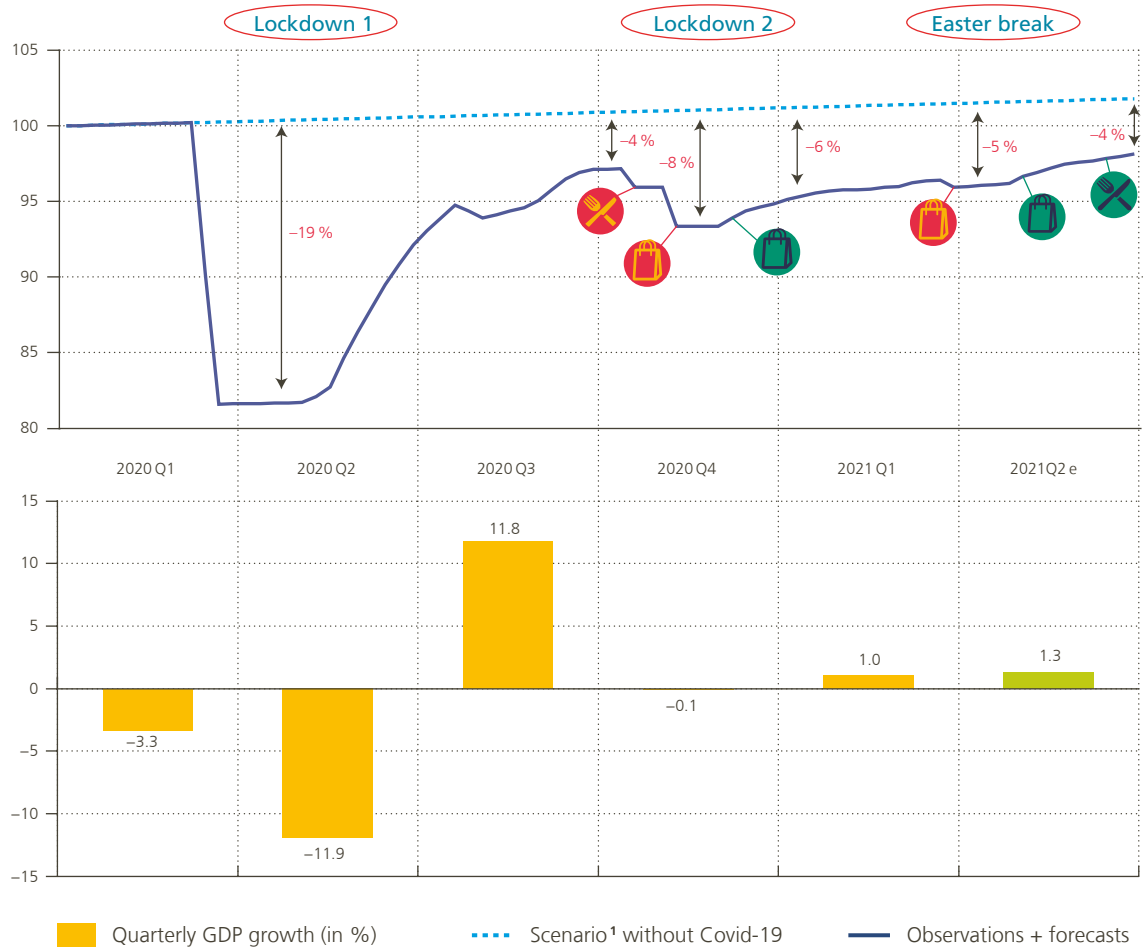
At the start of the second quarter of 2021, certain measures were tightened up again for schools, non-medical contact professions and retail. While this undoubtedly weighed on the affected businesses, the macroeconomic impact of this new containment episode should again be negligible, as shown in the surveys conducted by the Economic Risk Management Group (ERMG).[1] After the Easter holiday, further steps were taken and announced with a view to fully reopening the economy. As of May 8, bars and restaurants were allowed to open their outdoor facilities, for instance, for the first time since their mandatory closure in October last year, and they have been allowed to reopen completely in early June. While bars and restaurants only make up a rather small share in total Belgian value added, we expect their full reopening to act as a catalyst for the retail sector as well, as shoppers may now be more eager to return to the city centres. This may be amplified as the measures regarding telework are gradually lifted as well. Against this backdrop, we currently expect activity growth to edge up further, to 1.3 %, in the second quarter of 2021.

In addition, as in other euro area countries, the vaccination campaign is now in full swing. With nearly 40 % of the total Belgian population having received at least one dose of the COVID-19 vaccine (and 15 % being fully vaccinated) at the cut-off date for these projections, it seems more likely that an effective medical solution to the pandemic can be found as early as this summer. This is sooner than what had to be assumed in the baseline scenarios of the previous Eurosystem and NBB macroeconomic projections. The latter were still anchored to the

1 For more details on the results of the ERMG surveys, please refer to the various press releases issued via the dedicated page on the NBB website as of 3 April 2020.

Chart 1

The recent containment measures have had a limited impact on macroeconomic activity



Sources: NAI, NBB.

1 This corresponds to the growth profile projected in the NBB's Autumn 2019 projections.

technical hypothesis that such a medical solution would be gradually implemented by mid-2022. The earlier vaccination is clearly a game-changer. The experience of countries that are further ahead in the vaccination schedule (Israel, UK) shows that containment measures can be lifted before the estimated level of herd immunity is reached. Hence, it currently seems plausible that the most important remaining restrictions in the Belgian economy may already be lifted by the end of the summer holiday period, as the government envisages. One possible exception could pertain to social distancing measures and other safety measures that may remain in place for somewhat longer and could restrict the capacity of certain services industries.

The prospect of a gradual return to normal, coupled with strong demand in both the manufacturing and construction industries has already pushed up consumer and producer confidence far above their pre-pandemic levels in May. In fact, many industries are faced with longer delivery times, as supply cannot keep up with rapidly rising demand. The impact of those supply bottlenecks on actual output should remain limited for now as most firms can dip into their inventories or find alternative supply routes, albeit at significantly higher costs.

Hence, the stage is set for the Belgian economy to gain further traction well into the summer: the third quarter should see quarterly growth peaking at just below 2 % before it gradually normalises to a rhythm

that is more in line with potential growth by mid-2022. All in all, GDP is expected to grow by 5.5 % in annual terms this year, bringing output back to its pre-crisis level by the end of the year already. As growth moderates in the following years (in annual terms, 3.3 % in 2022 and 1.6 % in 2023), some persistent damage from the COVID-19 crisis will remain, albeit less than in our previous projections. By the end of next year, economic activity should still be 1.2 % below its pre-crisis path with no more catching-up in the following year.

4. Domestic demand and private consumption in particular will drive growth

All (non-public) demand components took a big hit during the spring lockdown in 2020. However, the paths of the various demand components diverged after that as they were affected differently by the subsequent containment measures.

In this respect, the resilience of business investment has been remarkable. While it fell by close to 25 % in the first half of 2020, it rebounded sharply, beyond the expectations of most observers, in the following three quarters. By the end of March 2021, business investment was already just 1 % below its pre-pandemic level, according to the current NAI statistics. This suggests that the sharp fall in the spring of 2020 was only due to the mechanical effects of the lockdown, which also weighed on the construction industry and deliveries, but that firms have generally kept investing throughout the crisis, despite the large uncertainty and notwithstanding earlier indications from surveys. While the latter pointed to a weaker and slower recovery of investment, the ERMG survey did suggest that large companies have shifted investment towards IT and digitalisation. The strong investment performance is consistent with the solid recovery in business confidence since the summer of 2020, to a ten-year high in April 2021.

Table 4

GDP and main expenditure categories

(seasonally adjusted volume data ; percentage changes compared to the previous year, unless otherwise stated)

	2019	2020	2021 e	2022 e	2023 e
Household and NPI final consumption expenditure	1.5	–8.7	3.8	7.2	2.5
General government final consumption expenditure	1.6	0.6	3.7	–0.1	0.9
Gross fixed capital formation	3.5	–6.9	10.9	2.1	2.4
General government	2.4	–1.4	13.2	0.5	8.5
Housing	5.2	–6.9	10.5	2.1	1.4
Businesses	3.2	–7.8	10.6	2.4	1.7
p.m. Domestic expenditure excluding the change in inventories [1]	*1.9*	*–6.0*	*5.4*	*4.0*	*2.1*
Change in inventories [1]	–0.4	0.0	–0.9	0.0	0.0
Net exports of goods and services [1]	0.2	–0.3	1.0	–0.7	–0.5
Exports of goods and services	1.0	–4.6	6.8	4.8	2.5
Imports of goods and services	0.8	–4.3	5.6	5.7	3.1
Gross domestic product	1.8	–6.3	5.5	3.3	1.6

Sources : NAI, NBB.

1 Contribution to the change in GDP compared to the previous year, percentage points.

The current projections see a continued recovery in business investment with the pre-crisis level already being reached by mid-2021. Throughout the projection period, the underlying determinants for business investment remain quite favourable with profit margins expected to recover and interest rates for firms assumed to edge up only slightly in the next few years. Moreover, the production capacity utilisation indicator in manufacturing is on the rise again and could signal the upcoming need for investment in additional production capacity. Hence, business investment should continue to expand, albeit at more moderate rates.

However, the further recovery should now be primarily driven by private consumption. Recent growth in private consumption has been bumpier than that of business investment. This is because consumer spending has been more directly affected by the sequencing of the containment measures. As restrictive measures were reintroduced in the fall of 2020, private consumption plummeted again in the final quarter of last year (after an initial strong recovery). The gradual relaxation of those measures since December 2020 led to a new – more limited – uptick of consumption in the first quarter of 2021 and the rebound should now gain traction as the whole economy gradually reopens. Consumption growth is likely to peak in the summer months also due to pent-up demand for certain services, including travel, but it should remain buoyant until the end of next year. We do not expect the quarterly growth rates to normalise until the last year of the projection period.

Despite the major economic crisis, Belgian households still saw their disposable income expand by 1.4 % on average in 2020 (or 1.3 % per capita). This is due to the automatic stabilisers and the massive government support measures, even though certain groups in the population have recorded big income losses. Purchasing power will continue to expand in the projection period, as the economy recovers, albeit at a slower rate in 2021 and 2022 due to the gradual withdrawal of the government support measures. Overall, disposable income should grow by more than 4 % in the 2021-2023 period, which amounts to a total gain in purchasing power of slightly more than 3 % per capita.

In 2020, Belgian households accumulated some € 25 billion in additional savings compared to the year before as the various containment measures got in the way of their usual spending patterns, Consequently, the savings ratio reached an unprecedented annual average of 21.7 %, mostly because of forced saving. The gradual normalisation of the savings ratio will fuel consumption growth as life returns to normal. By the end of the projection period, the savings ratio should have fallen to just above 14 %. This is still somewhat higher than the pre-crisis level, as households may anticipate future tax hikes, given the need for fiscal consolidation after the deterioration of public finances. The projected profile for the savings ratio (remaining above the 2019 level) also implies that the extra wealth that households have accumulated last year will not be tapped into much for "revenge spending". In this connection, we assume that higher-than-normal spending should remain limited to certain leisure categories (bars, restaurants, travel) and will, all in all, not take the form of a generalised spending spree that would temporarily push the savings ratio below the pre-crisis level. It should be kept in mind that the additional savings in 2020 were mostly accumulated by relatively well-off households with a lower marginal propensity to consume. In addition, financial statistics suggest that these excess savings have been invested more than usual in less liquid assets.

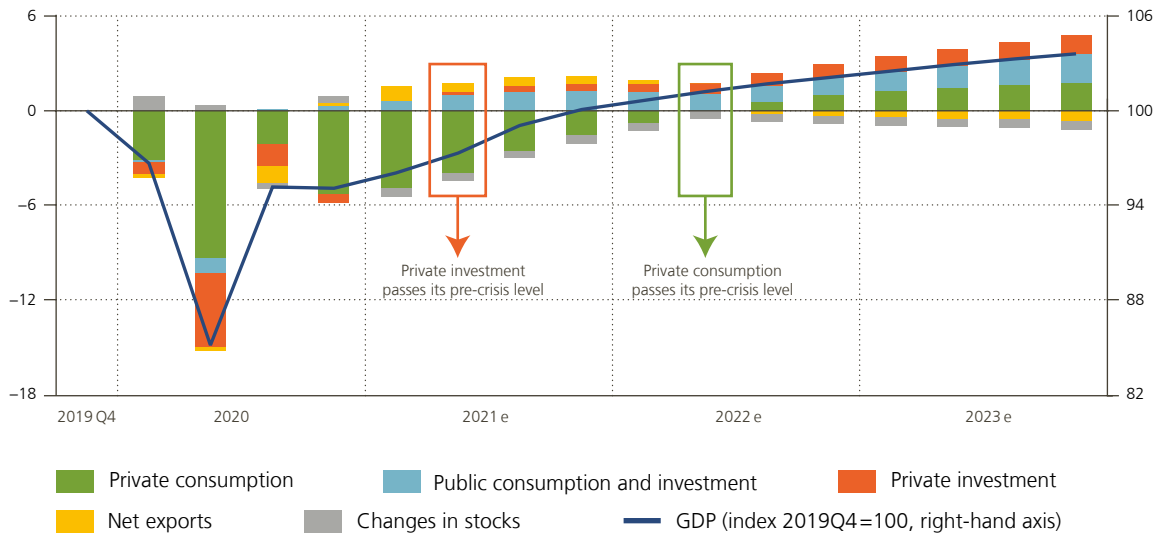
Finally, housing remains the key motive to save. In this connection, the very strong recovery in housing investment is quite remarkable. The decline in the spring of last year was most likely only due to work interruptions in the construction industry. From the second half of 2020 onwards, residential investment has rebounded spectacularly : according to the current quarterly statistics, housing investment had already significantly exceeded its pre-crisis level by the end of the first quarter of 2021. Full details behind those quarterly statistics are not yet known but anecdotal evidence suggests that the savings surplus was partly used by households to renovate their homes (which is recorded as investment spending rather than as consumption). Considering that the underlying fundamentals remain healthy, with historically low mortgage rates in particular, housing investment should continue to post solid growth throughout the projection period.

Export growth has come in strongly recently, reflecting favourable external demand, and it is projected to be largely driven by the assumptions on export market growth, even though Belgian exporters should face some

Chart 2

Net exports reduce GDP growth in the second part of the projection period

(contributions to GDP growth compared to 2019Q4; in percentage points, unless otherwise mentioned)



Sources: NAI, NBB.

1 Contribution to the change in GDP compared to the previous year, in percentage points.

market share loss throughout the entire projection period, in line with longer-term competitiveness trends. Imports typically exhibit a pattern that is roughly similar to that of exports, although they have recovered somewhat more slowly over the last few quarters and current statistics show a fall at the beginning of the year that may be related to Brexit. As domestic demand rebounds strongly over the projection horizon, so will import growth. In addition, the expected recovery of global tourism should be a drag on net exports as Belgians typically spend a lot more on tourism abroad than foreign tourists spend in Belgium. As a result, net exports will dampen GDP growth over the coming years.

Turning to public expenditure, public consumption is projected to grow strongly this year, due to increased outlays for healthcare in particular. It will shrink in 2022 as coronavirus-related temporary spending disappears. Government investment is set to rebound sharply in 2021. This takes into account government recovery plans but growth will remain fairly limited next year in the run-up to 2023, the year in which the usual local election cycle boosts investment.

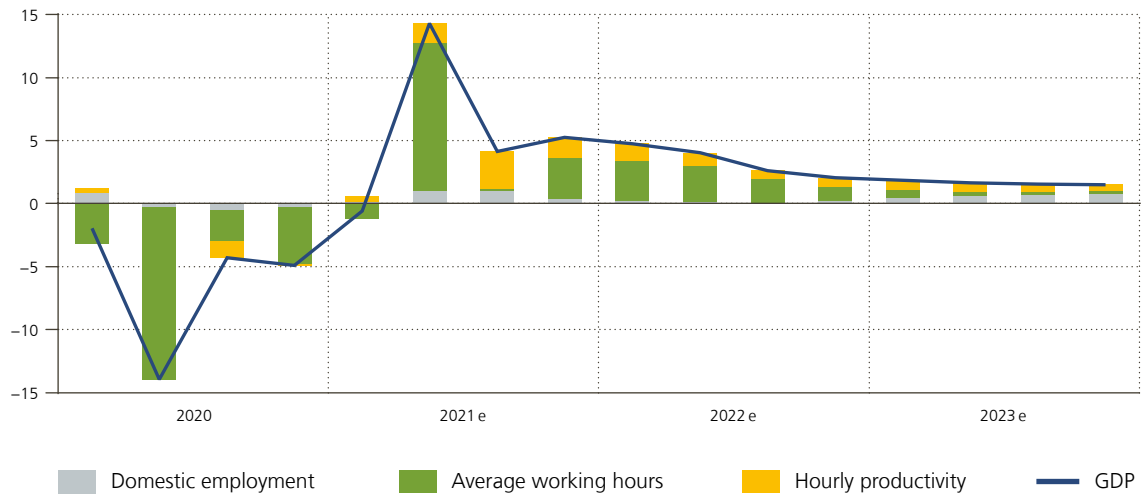
5. The labour market remains remarkably resilient

The total volume of hours worked decreased by 6 % in annual terms 2020 due to the sharp drop in the spring. This is just a bit less than the fall in real GDP. However, all in all, there was virtually no decline in employment, as job shedding in the first half of the year was offset by net hiring in the second. This is due to some labour hoarding at the level of the firm but primarily stems from the massive use of the temporary unemployment scheme for salaried workers and bridging rights for self-employed. The latter element explains the sharp fall in average hours worked. The recovery will technically be first supported by a rebound in the average working time. Productivity will also recover as rising demand will put more pressure on firms to use their available resources efficiently.

Chart 3

Domestic employment, working time and productivity

(contribution to GDP growth, percentage points, seasonally and calendar adjusted data)



Sources: NAI, NBB.

In the first quarter of 2021, some 470 000 people, accounting for over 12 % of salaried workers, were still affected by the temporary unemployment scheme (against a whopping 31 % in April 2020). As the economy rebounds strongly and the COVID-19 restrictions are lifted, the number of temporarily unemployed should gradually decline. In addition, the general application of the more flexible COVID-19 temporary unemployment scheme is currently scheduled to end on 30 September 2021.

The share of temporarily unemployed workers ultimately losing their job, while quite substantial in specific hard-hit industries, is now expected to be rather limited for the economy as a whole. Most of the workers affected by temporary unemployment will relatively easily return to regular employment, either in their existing jobs or in new jobs. Indeed, the number of vacancies has remained high and many industries already face increasing problems to hire new staff, given the strong recovery in demand. While a rising number of bankruptcies could lead to more job losses, this is likely to be offset by hiring by new firms or in other industries.

Variations in net job creations for salaried employment are mostly reflected in branches sensitive to the business cycle, even though employment in certain industries classified under other services has also been hit by the pandemic. Conversely, public administration and education have been more shielded during the crisis. Remarkably and unlike what has been observed in other euro area countries, the number of self-employed continued to grow in 2020. The structure of self-employment in Belgium, with a larger share of highly-educated people in professional and managerial occupations, and its long-term upward trend (against a declining trend in the euro area) can explain that positive outcome for 2020. The number of self-employed is expected to continue to rise over the projection period, albeit at a lower rate in 2022 and 2023, also taking into account the possible incidence of bankruptcies, in the hospitality and retail industries in particular.

All in all, the increase in unemployment should even be smaller than initially estimated. The harmonised unemployment rate is expected to peak at 6 % in 2022. This reflects the limited and gradual outflow to unemployment when the flexible temporary unemployment scheme comes to an end in September 2021. However, employment will accelerate again after that and the unemployment rate should already drop again in 2023. Hence, the labour market impact of the pandemic will remain quite limited, in comparison to the negative shock on economic activity.

Table 5

Labour supply and demand

(seasonally adjusted data; changes in thousands of persons, unless otherwise stated)

	2019	2020	2021 e	2022 e	2023 e
Working age population [1]	17	6	–2	10	15
Labour force	58	17	26	11	27
Domestic employment	76	–1	32	8	32
Employees	61	–15	16	3	25
Branches sensitive to the business cycle [2]	39	–28	6	–7	14
Administration and education	8	6	5	2	3
Other services [3]	14	7	6	7	8
Self-employed	14	14	16	6	7
Unemployed job-seekers	–19	18	–6	3	–5
p.m. Harmonised unemployment rate [4, 5]	5.4	5.6	5.8	6.0	5.9
Harmonised employment rate [4, 6]	70.5	70.0	70.0	70.0	70.3

Sources: FPB, NAI, NEO, Statbel, NBB.

1 Population aged 15-64 years. Working-age population estimations have been revised down by the Federal Planning Bureau, reflecting the impact of the pandemic with a higher mortality rate and lower net migration inflow.

2 Agriculture, industry, energy and water, construction, trade, hotels and restaurants, transport and communication, financial activities, property services and business services.

3 Health, welfare, community, public social services, personal services and domestic services.

4 On the basis of data from the labour force survey.

5 Job-seekers in % of the labour force aged 15-64 years.

6 Persons in work in % of the total population of working age (20-64 years).

6. The upcoming surge in inflation will remain temporary and limited

Labour costs have peaked in 2020. In addition to the negative impact of the aforementioned labour hoarding on productivity growth, this is primarily due to a technical element that can be traced back to the massive use of temporary unemployment. The latter has affected relatively more workers in lower-paid jobs, which means that the average wage per hour has temporarily increased significantly. This temporary composition effect should unwind in 2021 and 2022, which automatically reduces growth in average hourly wages in those years.

Turning to the more structural drivers of wage cost growth, the projections take into account a conventional wage increase of about 0.5 % per annum. For the 2021-2022 period, this reflects the maximum available wage margin of 0.4 % calculated by the Central Economic Council in addition to the agreed specific wage adjustments for the health and elderly care sector. These adjustments are financed via wage subsidies from the federal and regional governments, but the institutions concerned are mostly classified within the private sector. The associated wage increases amount to an additional 0.6 % (on top of the aforementioned 0.4 %) in the 2021-2022 period. For 2023, the projections are anchored to the technical assumption of a conventional wage increase of 0.4 %.

Apart from the unwinding of the aforementioned composition effect, the wage drift is generally positive. This reflects alternative ways of rewarding employees (e.g. one-off telework compensation) and specific

bonus schemes. In this connection and in accordance with a conciliation proposal of the federal government, considering that some industries have not suffered from the crisis as much as others, a one-shot premium could be negotiated in firms that did well during the crisis, as a top-up on the nation-wide 0.4 % margin. Finally, the wage drift projections also reflect the more structural trends affecting the employed population (older and better educated).

However, nominal hourly wage costs are primarily pushed up by price index-linking. The indexation is relatively low in 2021 but reaches an annual average of 1.8 % in the following years. All in all, hourly wage costs should increase by 2 % per year in the 2022-2023 period.

Table 6

Price and cost indicators

(percentage changes compared to the previous year, unless otherwise stated)

	2019	2020	2021 e	2022 e	2023 e
Private sector labour costs [1]:					
Labour costs per hour worked	2.2	3.5	0.3	1.9	2.0
of which:					
Conventional wages	0.7	0.6	0.5	0.5	0.4
Wage drift and other factors	–0.2	2.2	–1.1	–0.5	0.2
Indexation	1.8	1.0	1.0	1.9	1.7
Social contributions	0.0	0.3	0.1	–0.1	–0.1
Wage subsidies (–)	–0.1	–0.7	–0.1	0.1	–0.1
p.m. Labour costs per hour worked according to the national accounts [2]	*2.3*	*4.2*	*0.4*	*1.8*	*2.1*
Labour productivity [3]	0.6	0.4	1.4	0.9	0.8
Unit labour costs [1]	1.6	3.1	–1.1	0.9	1.2
Total inflation (HICP)	1.2	0.4	2.2	2.1	1.8
Core inflation [4]	1.5	1.4	1.2	1.8	1.6
of which:					
Services	1.8	1.8	1.6	2.1	2.0
Non-energy industrial goods	1.0	0.7	0.7	1.3	1.1
Energy	–0.8	–11.0	12.3	2.6	–1.0
Food	1.3	2.6	0.6	2.7	3.2
p.m. Inflation according to the national index (NCPI)	*1.4*	*0.7*	*1.5*	*2.0*	*1.6*
Health index [5]	1.5	1.0	1.2	2.0	1.6

Sources: EC, FPS Employment, Labour and Social Dialogue, Statbel, NAI, NBB.

1 Labour costs are not shown here according to the national accounts concept but according to a broader concept that also includes reductions in contributions for target groups and wage subsidies. That concept gives a better idea of the true labour cost for firms.

2 Excluding wage subsidies and reductions in contributions for target groups.

3 Value added in volume per hour worked by employees and the self-employed.

4 Measured by the HICP excluding food and energy.

5 Measured by the national consumer price index excluding tobacco, alcoholic beverages and motor fuel.

The projected normalisation of productivity should reduce unit labour costs growth in the recovery phase. Overall, they will increase by just over 1 % on average in the two outer years of the projection period.

Core inflation is expected to reach 1.2 % on average in 2021, down from 1.4 % in 2020. This decline is mainly determined by the low inflation rates observed over the first five months of the year, of 0.9 % on average. However, core inflation should rise significantly in the coming months. With economies reopening and supply constraints putting (temporary) pressure on input prices, transport costs and commodities, inflation for non-energy industrial goods is expected to rise. A similar upward trend is expected for services inflation in the form of "reopening inflation": businesses will be looking to offset some of the losses incurred during the COVID-19 lockdown, as well as the additional costs made for operating under COVID-19 rules, by charging higher prices to consumers, especially as the latter are willing to pay them, given long closures and significant additional personal savings. All in all, core inflation should rise quickly to about 1.6 % by the end of the year. At the same time, the price hikes should not fundamentally alter inflation expectations or start a wage-price spiral as price pressures (for both goods and services) should moderate somewhat beyond the near term. Core inflation is expected to weaken again around mid-2022. In annual averages, 2022 will see an increase to 1.8 % but core inflation will be slightly lower in 2023.

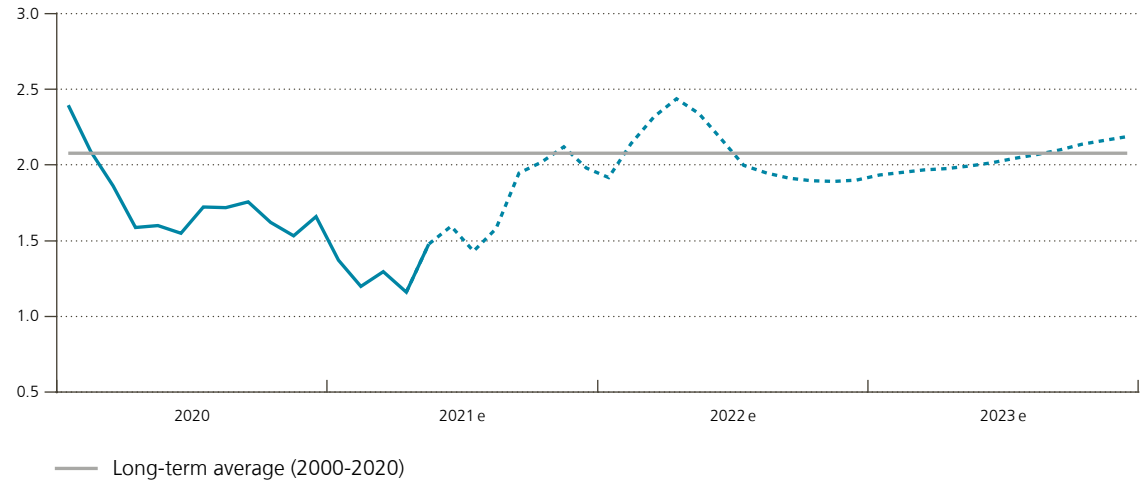
Total HICP inflation, which also includes the more volatile energy and food prices, is projected to pick up from 0.4 % in 2020 to nearly 2.2 % in 2021 and slow down slightly after that. Turning to the underlying components, the spike in 2021 is entirely due to energy prices that are expected to post double-digit growth in 2021 (after a decline in 2020), mostly reflecting higher Brent oil prices at the start of the year. Declining core and food inflation, on the other hand, are bringing down headline inflation. Energy inflation should moderate in 2022 and even turn negative in 2023, on the basis of the assumptions discussed in section 1, while, at the same time, core and food inflation are expected to pick up. The latter is partly explained by an expected further increase in excise duties on tobacco.

The national consumer price index (NCPI) is used to calculate the health index (see above), which excludes tobacco, alcoholic beverages and motor fuels, and serves as a reference for indexation of wages and replacement incomes. As electricity, heating oil and gas are taken into account in the health index, its growth rate picks up to 1.2 % in 2021 and even to 2 % in 2022. The threshold index for public wages and social benefits is next set to be exceeded in October 2021.

Chart 4

Services prices will accelerate in the short term due to "reopening inflation"

(year-on-year percentage change)



Sources: Statbel, NBB.

7. The general government deficit is expected to remain high after the pandemic

In 2020, the general government deficit ended up at 9.4 % of GDP, its highest level since the mid-1980s, though lower than expected at the end of last year, because fiscal stimulus turned out to be a bit less costly while the containment measures had also put the brakes on certain government expenditure.

In 2021, the deficit is shrinking somewhat, thanks to the strong economic rebound. However, it is expected to remain high, at 6.8 % of GDP. As the health crisis persists at least through the first half of the year, the government budget continues to support the economy. Tax revenues remain subdued, shoring up households' and companies' after-tax disposable income. The lengthening and extension of the temporary lay-off schemes for employees and bridging rights for self-employed workers further cushions income losses. Other discretionary measures, such as current transfers to companies forced to close or with substantially reduced turnover, solvency-boosting tax measures, and specific support measures to certain sectors (e.g. catering and events) continue to weigh on the budget. On top of this, health care expenditure is significantly higher due to the vaccination campaign and the normalisation in non-COVID-related medical treatments, that had been postponed in 2020. The stimulus measures and temporary replacement incomes weigh on the budget balance to the tune of roughly € 13 billion.

In the meantime, regional and federal governments are starting to roll out recovery initiatives centered around the Recovery and Resilience Plan, that was submitted in the context of the Next Generation EU recovery instrument. The plan kicks in in 2021 and is assumed to be ex-ante budget-neutral up to 2026. The expenditure, the bulk of which consists of public investment and capital transfers, is balanced by grants from the Recovery and Resilience Fund. In addition, regional authorities are unfolding supplementary recovery initiatives, that weigh on their budget balances. The projections assume a slightly more gradual increase for public investment than put forward in the governments' plans, as supply and administrative constraints might delay their implementation.

In 2022, the budgetary situation is expected to further improve, as the economy fully recovers from the COVID shock, leading to an unwinding of the temporary support measures. Yet, at a level of 4 % of GDP, the deficit remains above what was expected without the coronavirus crisis. In 2023, the budget deficit is expected to deteriorate again to 4.5 % of GDP, primarily on account of structurally increasing pension payments.

Table 7

General government accounts

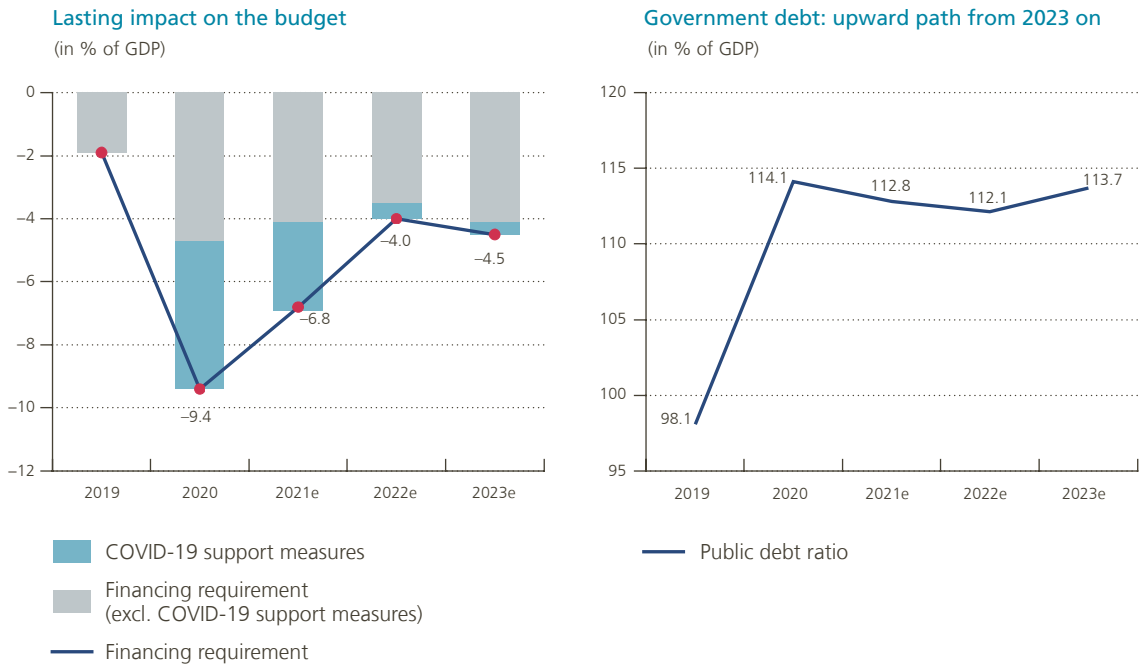
(in % of GDP)

	2019	2020	2021 e	2022 e	2023 e
General government					
Revenue	50.2	50.6	50.2	50.2	50.1
of which: fiscal and parafiscal revenue	43.1	43.5	43.1	43.0	42.9
Primary expenditure	50.1	58.0	55.4	52.8	53.2
Primary balance	0.1	–7.4	–5.2	–2.6	–3.1
Interest charges	2.0	2.0	1.7	1.4	1.4
Financing requirement (–) or capacity	**–1.9**	**–9.4**	**–6.8**	**–4.0**	**–4.5**

Sources: NAI, NBB.

Chart 5

Public finances badly hit by the COVID-19 pandemic



Sources: NAI, NBB.

Interest payments are expected to continue to shrink throughout the projection horizon, as interest rates remain far below the implicit interest rate on current outstanding debt. The debt ratio, that jumped to 114 % of GDP in 2020, temporarily stabilises over the projection horizon thanks to buoyant GDP growth this and next year. By the end of the projection horizon, however, debt is expected to get back on an upward path, as high primary deficits more than offset the downward impact on the debt ratio from interest rates remaining below trend growth. Therefore, bringing public finances back onto a sustainable path in the medium term requires structural measures to push up economic growth and consolidate public finances.

8. The baseline projections are still surrounded by (downside and upside) risks

Clearly, the uncertainty surrounding the baseline economic projections that are described in this article is still much larger than usual and intricately linked to the further development of the pandemic. The risks for the growth projections appear to be on the upside. Downside risks mainly relate to the medical situation: lower vaccine effectiveness (e.g. against new virus mutations) or acceptance could delay the lifting of the containment measures. This could depress growth longer.

In the short run, there is uncertainty regarding the length of the lockdown and income support measures. On the basis of the information available at the cut-off date for the projections, it is assumed that bars and restaurants will have been allowed to reopen completely as of June 9. Over the course of the summer, more relaxations are likely to follow, affecting larger events for example. However, the application of those relaxation measures still

appears to be conditional upon certain health criteria being met by that date. At the same time, the income support measures are expected to be phased out by the end of September. However, if the lifting of containment measures takes longer, it seems likely that income support would be further extended.

In addition to (the timing of) the policy decisions, the behaviour of economic agents in the current conditions constitutes an important source of uncertainty and may bring upward risks to the growth projections that outweigh the health-related risks. In this connection, the projected evolution of the household saving ratio is still key. With the economy gradually reopening and more activities becoming possible again, households may want to spend (part of) the wealth accumulated from extra saving in 2020. This would imply that the saving ratio could temporarily drop below its pre-crisis level in the projection period, which in turn would boost private consumption and growth more strongly than currently envisaged. Similarly, if these excess savings are not spent on consumption, they could also be tapped into more strongly for the purpose of housing investment. Furthermore, business investment is currently assumed to decelerate but it has surprised on the upside in the recent past. Firms may continue to invest at a higher pace, which would push up the growth outlook.

In the longer term, the unsustainable budget position will have to be addressed, which may require consolidation measures in the outer year(s) of the projection period. Depending on the specific measures that will be taken, the growth and budget outlook may be quite different.

Turning to the inflation outlook, risks are tilted to the upside, in particular for the near term. The ongoing recovery could generate more inflationary pressures, especially if current supply constraints turn out to be more persistent than expected or if companies pass on higher costs to a larger extent to consumers.

Annex

Projections for the Belgian economy: summary of the main results

(percentage changes compared to the previous year, unless otherwise stated)

	2019	2020	2021 e	2022 e	2023 e
Growth (calendar adjusted data)					
Real GDP	1.8	–6.3	5.5	3.3	1.6
Contributions to growth:					
Domestic expenditure, excluding change in inventories	1.9	–6.0	5.4	4.0	2.1
Net exports of goods and services	0.2	–0.3	1.0	–0.7	–0.5
Change in inventories	–0.4	0.0	–0.9	0.0	0.0
Prices and costs					
Harmonised index of consumer prices	1.2	0.4	2.2	2.1	1.8
Health index	1.5	1.0	1.2	2.0	1.6
GDP deflator	1.7	1.1	2.2	1.9	1.7
Terms of trade	0.8	0.2	–1.2	0.0	0.1
Unit labour costs in the private sector [1]	1.6	3.1	–1.1	0.9	1.2
Hourly labour costs in the private sector [1]	2.2	3.5	0.3	1.9	2.0
Hourly productivity in the private sector	0.6	0.4	1.4	0.9	0.8
Labour market					
Domestic employment (annual average change in thousands of persons)	75.6	–0.8	31.6	8.4	32.1
Total volume of labour [2]	1.3	–6.0	3.9	2.4	1.0
Harmonised unemployment rate (in % of the labour force aged 15 years and over)	5.4	5.6	5.8	6.0	5.9
Incomes					
Real disposable income of individuals	3.0	1.4	1.2	0.7	2.4
Savings ratio of individuals (in % of disposable income)	12.9	21.7	19.7	14.5	14.4
Public finances (in % of GDP)					
Primary balance	0.1	–7.4	–5.2	–2.6	–3.1
Budget balance	–1.9	–9.4	–6.8	–4.0	–4.5
Public debt	98.1	114.1	112.8	112.1	113.7
Current account (according to the balance of payments, in % of GDP)	0.3	–0.2	–0.3	–0.5	–0.6

Sources: EC, NAI, Statbel, NBB.

1 Including wage subsidies (mainly reductions in payroll tax) and targeted reductions in social contributions.

2 Total number of hours worked in the economy.

Technological innovation and green transition : where does Belgium stand ?

C. Swartenbroekx [1]

Introduction

Responses to the many challenges related to climate change are (partly) based on established technologies but will mostly rely on technological breakthroughs that can ensure, or even accelerate, the transition to a low-carbon economy. Given the growing concern about climate change across the world, the need to respond to the global challenge it presents is now pressing. So, technological development and innovation, which are considered as the source of an economy's prosperity and productivity growth, will also be an important driver of the structural changes in favour of a "greening" of production in many areas of activity and final consumption.

Substantial progress has already been made in several domains, but the technological advances needed require an acceleration both in the pace of innovation and in the application and deployment of the research and development (R&D) carried out. This is also an opportunity to develop low-energy products and components and reach new markets, modernise industries and infrastructure by making them more sustainable, while stimulating the economy to achieve the desired transition. New growth and job opportunities are likely to emerge.

This article discusses the importance of research and diffusion of green inventions in the economy to ensure sustainable economic growth. In continuity with the article in the December 2020 Economic Review on Belgian innovation capacity assessed through the prism of patent data, this article deals more specifically with innovation in "green" technologies. The context of green innovation is captured by using patent data. By its design (protection of the invention in exchange for mandatory public disclosure of the progress made), the patent system promotes innovation and the spread of new technologies. In this respect, it is a useful – although not perfect and incomplete – source of information to measure innovation capabilities and technological change. The analysis of the patent data aims to give an overall picture of the contribution of European and Belgian innovators and innovation eco-systems to the deployment of technologies that are beneficial to the environmental transition.

1. Inventive activity in climate change mitigation technologies

Achieving climate targets requires the production and consumption of more carbon-efficient goods and services for reducing greenhouse gas (GHG) emissions. This will affect all parts of the economy and society and will require green technological innovation and adoption worldwide of not only existing but also new and possibly disruptive

1 The author would like to thank Prof. Bruno van Pottelsberghe, Sarah Cheliout, Gert Bijnens and Emmanuel Dhyne for their constructive and valuable comments.

technologies. Some of them will have cross-cutting applications, while others will target specific activities. A wide range of solutions involve nanotechnology, biotechnology, additive manufacturing or materials technology.

1.1 Green innovation through the lens of patent data

Patent data serve as a measure of technological innovation as they relate to the output of the inventive process. Thanks to the temporary protection and exclusive commercial rights for owners of patented inventions, the patent system provides an incentive to innovate and facilitates the dissemination of new technologies (better visibility of technological change, improved transaction processes). In terms of their use for statistical analysis, patent data include a wealth of information on the nature of the inventions, their inventors and the owners of the patents (referred to as "applicants").

However, it is worth mentioning that patent-based indicators are subject to measurement issues that can be partially corrected or should at least be kept in mind[1]. While the propensity to patent may reflect greater inventive activity, it may also be motivated by other – regulatory or fiscal – considerations. Not all inventions are patented; there is no obligation to patent and other means of intellectual property rights protection are available. Regarding innovation, not all patented inventions necessarily lead to an industrial application or marketable product. In terms of statistical reporting, the availability of patent data is subject to a delay of at best 18 months between the priority date and their publication by the patent office that received the application. If patent families are considered (a patent filed in at least two jurisdictions), then the timeline may go up to 32 months.

Given the growing interest in analysis of green innovation efforts, the European Patent Office (EPO) has developed a dedicated tagging scheme to target patents covering "*technical achievements which directly or indirectly either help reduce the emission of greenhouse gases or actively enhance the sinks of such gasses*" (Angelucci, 2018). It identifies climate change adaptation and mitigation technologies (Y02 category) and technologies linked to smart grids (Y04S category). The related Y02/Y04S classes are exclusively used to label patent applications which are already classified or indexed in the Cooperative Patent Classification (CPC) system, but which fall within the broad definition of these green technologies. The EPO Worldwide Patent Statistical Database (PATSTAT database) and its Y02 classification make it possible to monitor technological developments and identify cross-cutting technologies that can mitigate climate change and which do not systematically correspond entirely to a section of the CPC. The identified patent documents relating to climate change mitigation technologies (CCMTs) are classified between seven sub-classes organised around the many areas within which these technological achievements apply. If deemed appropriate, a patent document can receive more than one indexing code of these sub-classes.

The analysis below is based on data relating to CCMTs, excluding climate change adaptation technologies. This latter (Y02A) classification covers adaptation technologies to preserve coastal zones, water supplies or resource conservation or efficiency, agriculture, forestry, livestock or food production, adaptation technologies in human health protection and protecting infrastructure or their operation (resilient infrastructure). The separated Y04S dedicated to smart grids has not been considered either even if it is closely connected to the Y02 as it concerns systems integrating technologies and information and communication technologies (ICT) for improving electrical power generation, transmission, distribution, management or usage. About two-thirds of the smart-grid Y04S categories relate to CCMTs and patent documents tagged under Y04S will often also be coded under Y02B (interactions with end-user applications), Y02E (electric power system management) or Y02T (interoperability of the electric and hybrid vehicles with the power network) (Angelucci *et al.*, 2018).

1 For a survey on patent measurement issues, see Cheliout S. (2020), "Belgium's innovative capacity seen through the lens of patent data", NBB Economic Review, December. The various counting methodologies and their impact are presented in Dernis *et al.* (2001). For international comparisons de Rassenfosse *et al.* (2013) illustrate the importance of the jurisdiction(s) considered to compute statistical series. The link between innovative efforts (R&D expenditure) and patent filings is complex, as shown by de Rassenfosse *et al.* (2013). The authors suggest – and provide evidence – that this link is imperfect, due to three factors: heterogeneous research productivity (not all research projects lead to useful inventions); heterogeneous propensity to patent (once the invention is made, do you patent it or not?); and heterogeneous strategic propensity (once you patent an invention, how many patents do you file?).

Table 1

Climate change mitigation technologies distributed across many areas

Y02B	CCMTs relating to buildings	Integration of renewables in buildings, lighting, heating, ventilation and air conditioning, home appliances, constructional or architectural elements improving the thermal performance of buildings
Y02C	Carbon capture and storage (CCS)	CO_2 and GHG emissions capture and storage
Y02D	ICT aiming at the reduction of their own energy use	Energy-efficient computing, techniques for reducing energy consumption in wireline/wireless communication networks
Y02E	CCMTs relating to energy generation, storage and distribution	Renewable energy sources (RES) production, efficient combustion, nuclear energy, biofuels, efficient transmission and distribution, energy storage (hydrogen, batteries, fuel cells)
Y02P	CCMTs in industrial processing or production activity	Metal processing, chemicals/petrochemicals industry, minerals processing (cement, lime, glass), food industry
Y02T	CCMTs relating to transport	E-mobility, hybrid cars, efficient internal combustion engines, efficient technologies in railways, air and waterways transport
Y02W	CCMTs in waste and wastewater treatment	Wastewater treatment, solid waste management, bio packaging

Source: EPO.

In combination with patent statistics tools, the tagging scheme makes it possible to map the development of sustainable technologies within the PATSTAT database which represents some 18 million records of patent data (with all CPC classes) filed and registered at the EPO over the period 2000-2016.

1.2 Inventive activity in CCMTs worldwide

To place the CCMT patent landscape in context, we first investigate the inventive activity in these fields worldwide, considering patents filed in all jurisdictions as reported in the OECD Environment database (OECD/ENV). To sketch the inventive activity across countries and years, we elaborate on patent statistics based on country of residence of the inventor(s) and priority date, which is the closest date to the research activity and invention. Patent families are considered here, which include the subsequent international patent applications associated with a priority filing. The larger the patent family, the higher the potential value of the invention, as it bears additional costs for the patent owner, and a willingness to enter foreign markets. As a unique patent may have many inventors (or applicants) located in different countries, it is divided equally amongst all of them and their corresponding country of residence (fractional count method, see Dernis *et al.*, 2001) to avoid multiple counts in establishing the geographic origin which then better reflects the effective contribution of each country to the inventive activity. Patent counts in absolute numbers are aggregated around the specific CCMTs to sketch how these technologies are developing and evolving across countries[1].

1.2.1 After a strong increase, patent filings relating to CCMTs have levelled out in recent years

There has been a rapid growth in the number of green patents filed worldwide over the past 25 years and particularly since 2005. Record numbers of green patents have been filed globally, reaching 35 200 patents at the highest point in 2012. Green inventions have grown much faster than in other areas, to the extent that CCMTs in the years 2015-2016 account for 9 % of the world's inventions, up from 4 % in the 1990-1994 period. Between 2000 and 2012, the number of new climate-change-mitigation inventions patented globally grew at an annual rate of 10 %, more than triple the rate of innovation in all technologies. Patent registrations for CCMTs started to slow in the five years following the 2008-2009 financial crisis and even declined from 2012 on in

1 See appendix on several concepts around patenting used in this article.

specific technological fields, in contrast to the findings for other flourishing sectors (health-related technologies and ICT) (IEA, 2019).

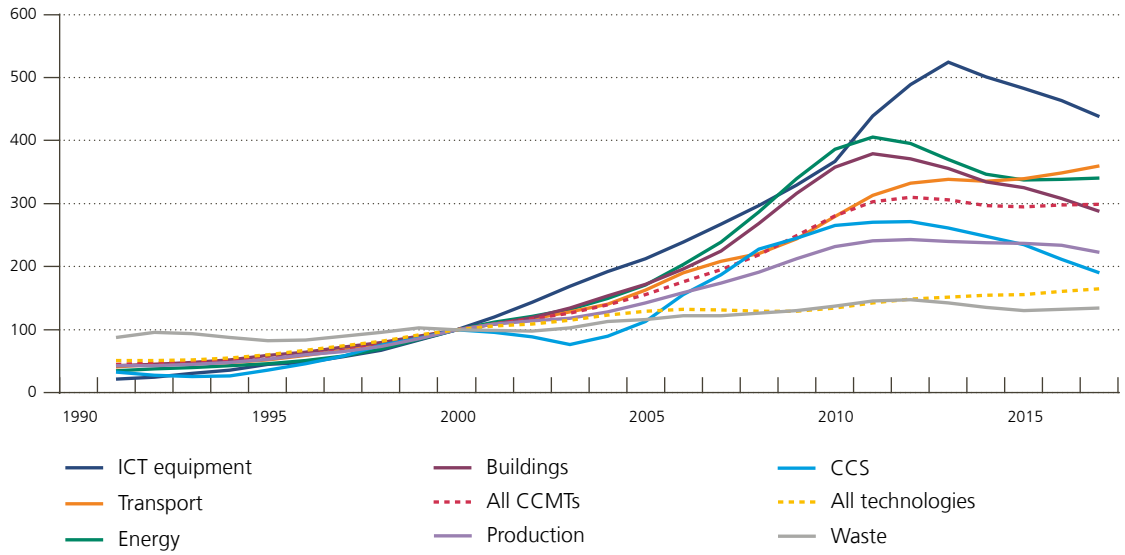
Several factors may be behind this trend. Public policies support the development of green technologies. The adoption and reinforcement of environmental regulations, whether in the form of compulsory standards on equipment (for instance, on electricity and heat production equipment to reduce sulphur dioxide (SO_2) and nitrogen oxide (NOx) emissions with pollution-abatement techniques) or because of the change in relative CO_2 prices that climate change regulations trigger (induced innovation when profit-motivated R&D and inventors expect higher benefits) drive the development of low-carbon technologies. The higher energy prices incurred by those policy measures are associated with wider green patenting. Moreover, much of this innovation response occurs within the space of five years (Dechezleprêtre *et al.*, 2016). The fall in oil prices since mid-2014 reduces the value of future energy savings and/or alternatives to fossil fuels as well as the incentive to go green. Based on patent data in car technologies, Aghion *et al.* (2016) have shown that higher fuel prices boost innovation in low-carbon technologies while curbing it in high-carbon ones. A similar rationale can be used with regard to the CO_2 price to be paid by large (EU-ETS-regulated) emitters (Calel *et al.*, 2016). Increasing technological maturity of several CCMTs may also explain the slowdown in patenting activity with further developments working with the existing (patented) innovations as in solar PV, for instance (IEA, 2019). Finally, the loosening of environment-friendly policies – not to mention the end of the United States' membership of the Paris Agreement – might also have reduced the pace of innovation in the United States. A surge in CCMT patents may well be expected in the coming years, given the drastic change in policy with ambitious green targets for the future and, on the European side, implementation of the Green Deal on which the European recovery depends to support future economic growth.

Importantly, these declining low-carbon innovation efforts are not a meaningless observation, given the time lag between innovation and market diffusion at a reasonable economic cost for large-scale deployment. This change

Chart 1

Growth of worldwide yearly patent applications for CCMTs [1]

(index 2000 = 100 [2])



Source: OECD/ENV.

1 All known patent families worldwide are considered. Refers to inventions filed in two or more jurisdictions (patent family size equal to or larger than two).

2 Index of 3-year moving average.

has been particularly striking across the energy (Y02E) and buildings (Y02B) classes. This downward trend is not visible in the maritime and air transport CCMTs (Y02T) which have moved higher up in environmental policy discussions in recent years.

1.2.2 Nevertheless, CCMT patents represent a rising share of the overall innovation effort

At the peak of patent filings around 2010-2014, those related to CCMTs accounted for some 10 % of all patents filed by European inventors, double the proportion in 2000-2004. It is true that the rate of growth of low-carbon innovation activities reflected in patents has accelerated in Europe from 2005 onwards, which coincides with the implementation of the EU ETS mechanism. However, even if it appears that the introduction of the mechanism has led to a 10 % increase in the patenting of CCMT-related inventions among EU-ETS-regulated firms, the EU ETS accounts for only about 2 % of the post-2005 surge in low-carbon patenting in Europe (as it has not affected patenting of non-EU-ETS-regulated companies) (Calel *et al.*, 2016). Denmark's notable performance and specialisation in CCMT patenting (nearly 20 % of patent applications with inventors located in Denmark are in the field of CCMTs) are linked to its very active research and innovation-oriented low-carbon industries which have an average of 9 out of 100 employees working in the field of research and innovation compared to on average 5 out of 100 employees in traditional Danish companies (Danish NECP, 2020).

Table 2

Share of CCMT patents in the total patent portfolio [1]

(in % of the patent portfolio of each country/zone, average over periods)

	2000-2004	2005-2009	2010-2014	2015-2016
World	5.3	7.6	10.3	9.3
Japan	6.7	7.9	11.1	10.1
United States	4.6	7.5	10.0	9.3
EU28	5.0	7.9	10.9	9.8
Germany	5.8	8.5	11.6	10.4
France	4.8	7.9	11.4	10.3
The Netherlands	3.9	6.5	8.6	7.2
Belgium	4.1	5.6	7.9	7.7
Denmark	5.5	14.7	20.1	18.3
South Korea	4.9	7.8	12.8	12.1
China	4.5	6.4	7.6	6.9

Source: OECD/ENV.

1 All known patent families worldwide are considered. Refers to inventions filed in two or more jurisdictions (patent family size equal to or larger than two). Fractional patent counts are based on the priority date and the inventor's country of residence.

1.2.3 Innovation in digitalisation supports CCMTs development

Table 3 shows that the changes triggered by rising digital technology and innovation in CCMTs are noticeable in the energy system, i.e. in the way stakeholders produce and consume energy as digital technologies enable a multi-directional and highly-integrated energy system. The energy sector has been a traditional user of digital technologies for grid management. It further develops smart electricity grids to mainstream decentralised production from renewable energy sources (RES) in the electricity system on an efficient and reliable way. These innovations also have applications for buildings enabling demand-side response thanks to intelligent home systems connecting devices to reduce peak loads or store energy in batteries. Digitalisation is key for

Table 3

Rate of penetration of digital technologies in CCMTs

(in % of patent families[1] which include both the technology field considered and at least one class related to ICT)

	1990	2000	2005	2010	2015	2018
All technologies	23.0	34.9	40.3	39.8	39.8	40.0
Health technologies	3.8	5.6	8.2	9.3	10.5	8.8
CCMTs	9.3	18.0	24.1	29.8	25.2	23.5
Buildings	14.1	21.2	27.8	34.0	24.8	37.4
Energy	18.8	26.1	26.6	36.7	29.3	37.1
Production	10.0	20.7	24.5	29.2	22.7	17.8
Transport	1.6	2.9	8.4	10.6	4.4	4.4

Sources: OECD/ENV and IEA (2019).

1 Patent family size equal to or larger than two.

autonomous driving, connected and electrified vehicles (EVs), and shared mobility which will eventually shape all road transport modes. It leads to the development of new services such as those made possible by smart mobility applications for real-time passenger and freight transport dispatching. One-quarter to one-third of CCMT patents are tagged as related to ICT and this share reaches almost 40 % in energy and buildings CCMTs. As energy technologies develop, advances in design, conception and operation increasingly rely on innovation in ICT. Hence, climate change mitigation will also benefit from the research effort on digitalisation in general, making the energy systems more connected, smart, efficient and reliable.

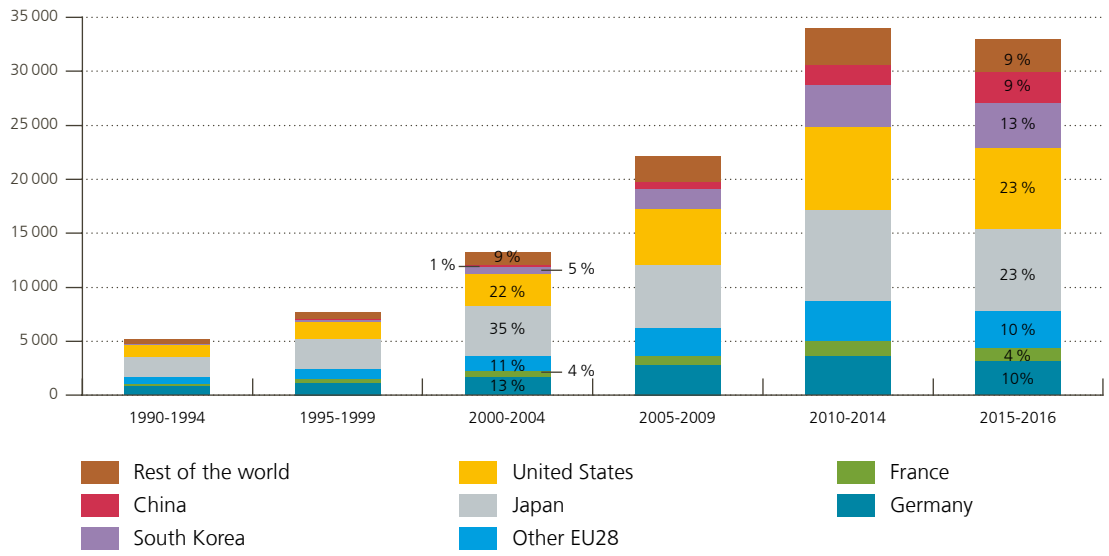
1.3 CCMT inventions are mostly developed by inventors from major economies …

In terms of the geographical origin of patent applications, 70 % of CCMT patents worldwide are brought by American, Japanese and European inventors. With the consequent development of inventive activities in green technologies in China and Korea, Japanese and European inventors are losing ground. Chinese inventors have been particularly active in patenting, with annual green patents filings almost twenty times higher in 2015-2016 compared to 2000-2004. This exponential growth is due to the strong growth of patent applications in China and is a consequence of the broader context of innovation policy: in the late 1990s, policies to boost innovation among Chinese inventors were put in place with the ambition of the authorities to move China up the value chains by producing more goods of higher value. In 2006, the authorities implemented so-called

Chart 2

Number of patents by inventor's country of residence

(yearly number of CCMT patents and share by origin in % [1])



Source: OECD/ENV.

1 All known patent families worldwide are considered. Refers to inventions filed in two or more jurisdictions (patent family size equal to or larger than two). Fractional patent counts are based on the priority date and the inventor's country of residence.

indigenous innovation policies aimed at promoting domestic innovation by boosting R&D capabilities of domestic high-technology manufacturing industries. There is strong support from public funding programmes through the national key R&D projects,15 out of 64 of which are currently dedicated (fully or partially) to R&D in clean energy (IEA, 2020a and Development Solutions Europe Ltd, 2019).

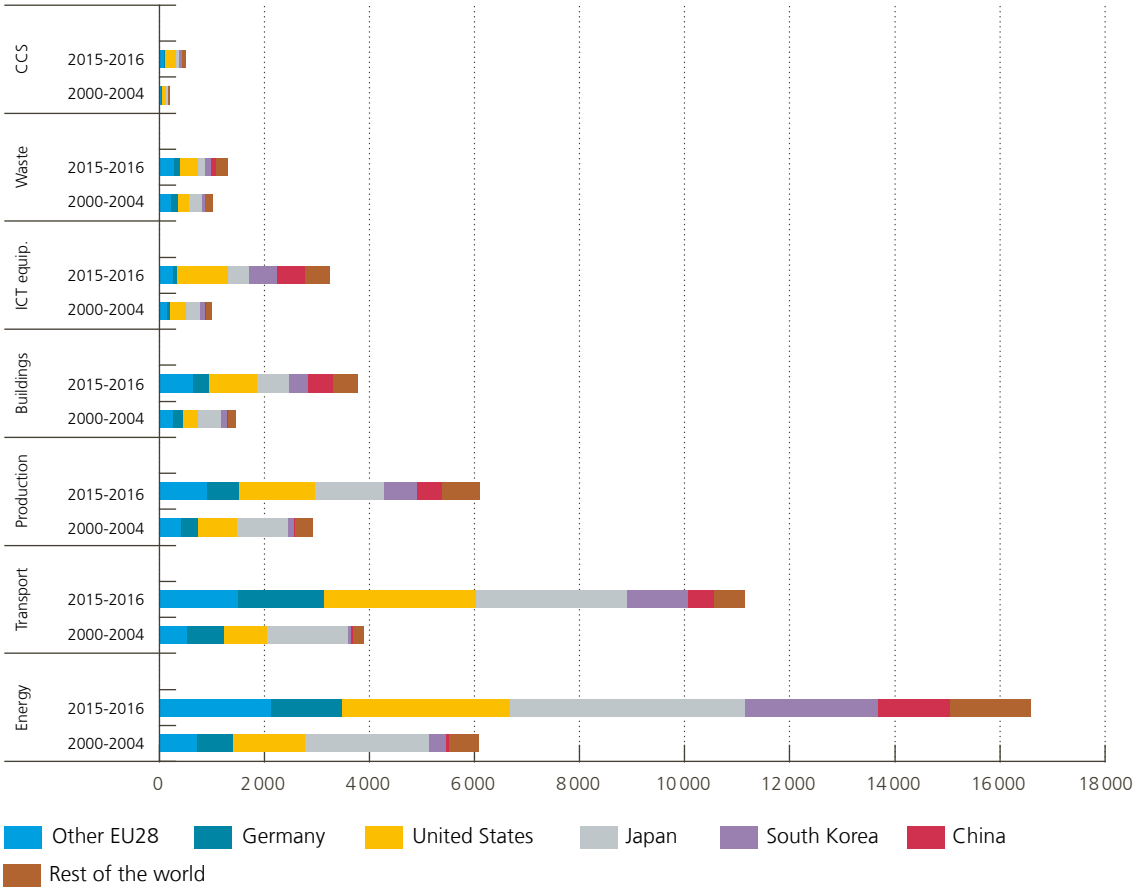
1.4 … with specialisation in some fields

On a global scale, most patented inventions are in green energy production and transmission, transport and production processes. Patented inventions in waste and wastewater management and in production processes have seen more moderate growth and seem to be more mature. Future technology improvements in waste management are in line with the relative decoupling of primary materials use and stimulate the transition to a more circular economy. The European Commission's March 2020 "Circular Economy Action Plan" aims to reduce the EU's materials consumption footprint and double its circular material use rate (ratio of the circular use of materials to overall material use). The need to drive innovation in how material resources are used and re-used has been acknowledged in this Action Plan. More generally, patenting activity in the respective technology fields also reflects the efforts made upstream in terms of R&D investment. The provision of policy incentives for the development of specific technologies such as the feed-in tariffs on solar and wind energy production – requiring utilities to buy the power produced at a rate above the wholesale price of electricity – in Germany (1991), Denmark (1993) or Spain (1994) has introduced conditions to make these technologies more attractive to develop for industries and markets. It is also consistent with the EU's renewable energy target introduced in 1997. In all fields, the relative share of inventions from the EU28 is declining, as it is for Japan. Chinese and Korean inventors are taking an ever more visible position in the fields related to energy and ICT equipment (energy-efficient wireline and wireless communication networks with low power mode, for instance).

Chart 3

Number of patents by CCMT field and by inventor's country of residence

(yearly number of CCMT patents [1])



Source: OECD/ENV.

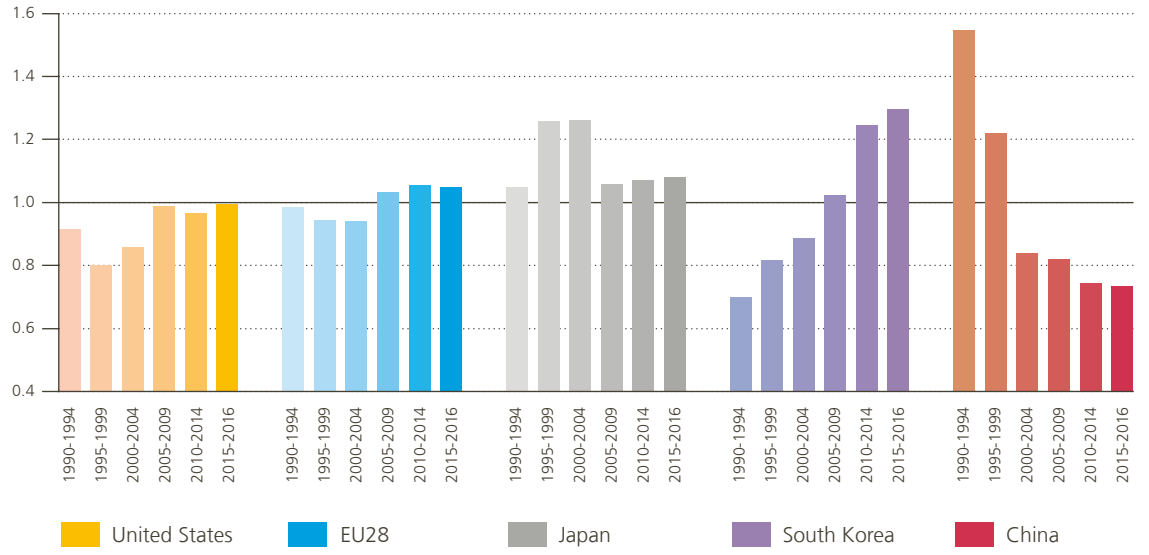
1 All known patent families worldwide are considered. Refers to inventions filed in two or more jurisdictions (patent family size equal to or larger than two). Fractional patent counts are based on the priority date and the inventor's country of residence.

There is a growing specialisation in the EU28 from 2004-2005 onwards: its revealed technological advantage (RTA) index is above one, which means that the percentage of green patents among a country's total patents is higher than the percentage of green patents worldwide, reflecting a relative better performance in CCMTs than the overall innovation record. The United States and China do not appear to be highly specialised, unlike South Korea, which quickly specialised and Japan which has always devoted a larger share of its overall innovation effort to CCMTs.

Chart 4

Revealed technological advantage index

(index > 1 means relative specialisation i.e. % green patents among total patents for country j > % green patents worldwide[1]; index world = 1)



Source: OECD/ENV.

1 All known patent families worldwide are considered. Refers to inventions filed in two or more jurisdictions (patent family size equal to or larger than two). Fractional patent counts are based on the priority date and the inventor's country of residence.

2. Focus on Europe's inventive capabilities in CCMTs

In the current and subsequent sections, the focus will be on the applicants of CCMT patents, as opposed to their inventors, or their country of residence, analysed in the previous sections. Figures on applicants – or patent owners – by geographical origin of CCMT patents provide an indication of their interest to protect their inventions on the European markets and how far they see a potential to develop and to sell them, that is, their market reach. Patenting activity in the European market – and Belgian market in section 3 – is assessed on the basis of one reference office, the EPO, in order to avoid bias due to differences in patent regulations and changes in laws over time. Direct applications filed with the EPO and international Patent Cooperation Treaty (PCT) applications for which the EPO is the designated International Search Authority – the so-called Euro-PCT applications – are considered too, still displayed by priority date. This also reflects some value given to these technologies by the applicants who have taken the step of patenting them at the European market level, which means wider – and more costly – protection than solely applying for a patent at national level. Fractional count is used to avoid multiple counts when applicants from different countries are concerned. Fractional count is also used at total CCMTs level when a patent document has received more than one indexing Y02i code (the patent is related to several CCMT fields); otherwise it would generate double counts and potentially bias the analysis.

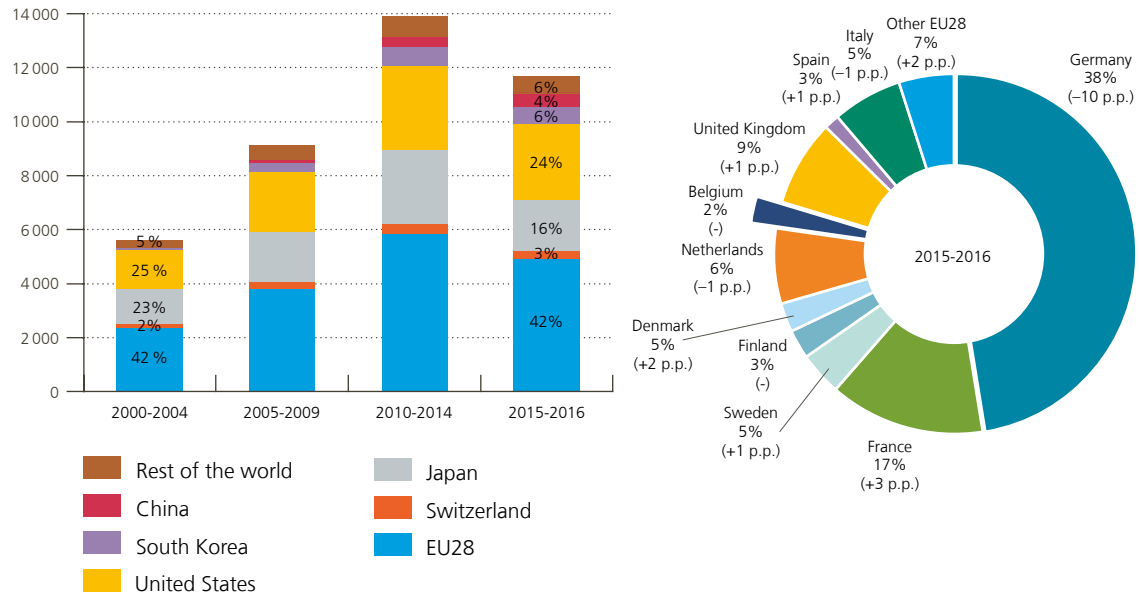
2.1 In Europe, most patenting activity is carried out in a few countries

Yearly CCMT patent filings with the EPO by EU28-based applicants increased by 5.3 % a year on average between 2000 and 2016 and accounted for some 42 % of patents. A geographical bias in favour of European applicants may influence this result with domestic applicants tending to file more patents in their home

Chart 5

Number of patents filed at the EPO by applicant's country of residence

(left: yearly number of CCMT patents at the EPO from all world economies[1];
right: share within the EU28 in 2015-2016 in % and difference to 2000-2004 in percentage points)



Source: EPO (PATSTAT).

1 Aggregate data at total CCMTs level corrected for multiple counts as patents may be classified in more than one Y02i technology class.

country/zone than non-resident applicants[1]. As already mentioned, European patent applicants have maintained the pace of new patents across all CCMT fields, similarly to the United States. This is less the case for Japan, which at the turn of the century was the first to file CCMT patents but is now being challenged by the United States, the EU28 and South Korea.

Patent filings by non-European applicants are an indicator of the willingness of multinational and/or non-EU firms to protect their innovations on the European market and to what extent it is an attractive and strategic place for CCMT development. Put another way, Europe's market commercial attractiveness for climate-driven technologies can easily be gauged. Behind the size and the potential of the market, the propensity to patent may be further motivated by the quality of intellectual property regulations and the reputation of the patent office (regarding rules or cost of patenting). American and Japanese green patent applications have gradually lost ground to the benefit of other non-European players (patents filed for Chinese and Korean inventions).

The patenting activity of European applicants in CCMTs is highly concentrated in a few European countries. Patent applicants from only five countries – Germany, France, United Kingdom, the Netherlands and Sweden – are accountable for 75 % of the applications filed by EU players. Among these European applicants, Germany emerges largely ahead of France, but its relative position has deteriorated: the number of green patents filed in 2016 has fallen by 33 % compared to the maximum level reached in 2011 (mainly in renewable energy in absolute numbers).

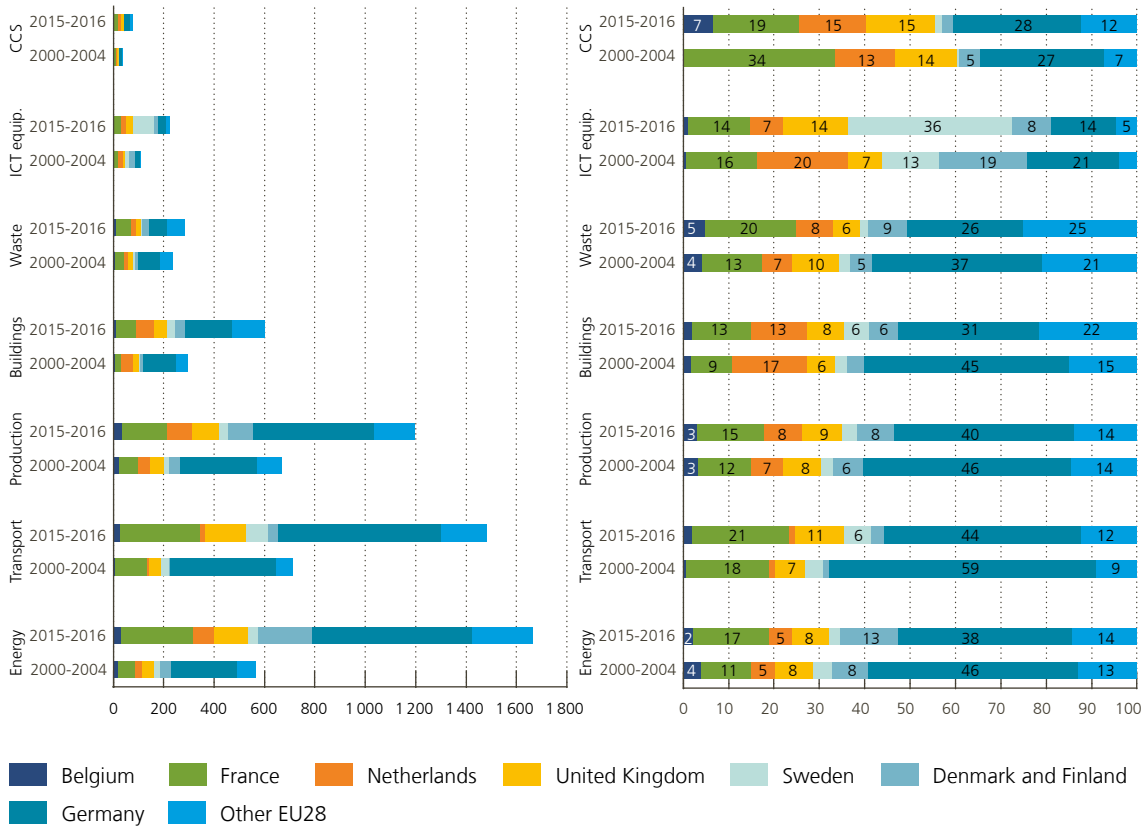
The increase in the number of CCMT patents is seen across all technology classes; it is less marked in technologies relating to waste management and manufacturing processes linked to metallurgy, food processing, chemicals, non-metallic minerals (glass, cement). For the latter, the search for innovation was already well

1 This is even more the case here as it concerns patent applications filed with the EPO which cover 38 countries including all EU27 Member States, UK, Norway, Switzerland, Turley, Iceland, Albania, Liechtenstein, Monaco, North Macedonia, Serbia and San Marino.

Chart 6

Number of patents field at the EPO by applicants from European origin by CCMT field

(left: average of yearly number of CCMT patents filed at the EPO;
right: country share within the EU28 in %)



Source: EPO (PATSTAT).

under way (energy-intensive industries seeking to reduce the cost of energy inputs, heavy industries with high GHG emissions, mostly subject to the EU ETS). There was no such strong increase in patenting activities as for technologies related to transport and particularly clean energy production, sectors in which environmental regulations play an important driving role.

Looking further into energy-related CCMTs, patenting from EU28 countries have been strong compared to the rest of the world in wind rotors, in advanced biofuels and in solar thermal energy. Germany is by far the leader in patenting for geothermal technology and industrial heat recovery. In wind energy, the largest share of patent applications is in the onshore wind turbine segment and patents by EU-based entities are filed in multiple patent offices worldwide. Historically, more patent applications for batteries have been filed outside Europe and even though France and Germany stepped up patenting and R&D public spending, the EU is still catching up. Most building-related CCMT patents are in micro-generation and thermal energy storage but patenting activity in district heating is extremely low (due to the maturity of core technologies and the small number of companies involved); the share of heat pump patents has been steadily rising, however. Germany dominates activity in CO_2 capture technologies, followed by France and the Netherlands. These countries were also among the four countries with interest in CO_2 storage, together with Austria. CO_2 storage and transport projects are typically driven by global gas and oil companies including outside of Europe. The market for CCS technologies may be relatively small today, but there are high expectations of potential growth with higher CO_2 prices and as a technology to offset GHG emissions (EC, 2020b).

2.2 How do European countries position themselves in patenting green technologies?

Unsurprisingly, the ranking of countries according to the number of green patents filed annually is overwhelmingly influenced by the major economies, including of non-European origin. In the recent period, both Korea and China have climbed into the top 10. Korea was already 11th in the ranking in 2000-2004 and is now in 5th place. China has moved 12 places upwards. Since 2000 the number of Belgian CCMT patents has doubled (between 2000 and 2016: 62 to 124) and Belgium could keep its position being just overtaken in this ranking by Spain. The 120 annual CCMT patents filed represent 8 % of all Belgian patents filed at the EPO in 2015-2016.

Besides reflecting the innovative capacity of a country, legal aspects may also influence this ranking based on patent counts. German law on employee inventions promotes the propensity of German companies to patent because any invention made by an employee must be immediately reported to their employer who has a right of first refusal for four months. If the employer decides not to file a patent, the invention and all rights and obligations associated with it revert to the employee. The structure of the business fabric, more specifically companies' size distribution may interfere too, because larger companies tend to have a higher patent propensity.

Table 4

Top 20 countries ranked according to their number of patents filed at the EPO in CCMT fields[1]

(in absolute numbers[2] and divided by the population in millions of inhabitants, unless otherwise stated)

Country	Fractional count					Country	Fractional count per million of inhabitants				
	2000-2004	Rank 2000-2004	2015-2016	Rank 2015-2016	Rank change		2000-2004	Rank 2000-2004	2015-2016	Rank 2015-2016	Rank change
US	1 418	1	2 787	1	0	DK	11.5	4	39.4	1	3
JP	1 310	2	1 901	2	0	CH	18.1	1	37.3	2	–1
DE	1 131	3	1 850	3	0	SE	10.4	5	26.8	3	2
FR	333	4	852	4	0	FI	12.0	3	26.1	4	–1
KR	80	11	659	5	6	DE	13.7	2	22.6	5	–3
GB	184	5	449	6	–1	AT	8.7	8	19.2	6	2
CN	16	19	439	7	12	NL	10.0	7	17.1	7	0
CH	132	8	310	8	0	JP	10.3	6	15.0	8	–2
NL	161	6	291	9	–3	KR	1.7	17	12.9	9	8
SE	93	10	264	10	0	FR	5.4	10	12.8	10	0
IT	150	7	255	11	–4	**BE**	**5.5**	**9**	**10.6**	**11**	**–2**
DK	62	14	225	12	2	US	4.9	11	8.7	12	–1
AT	70	12	166	13	–1	GB	3.1	13	6.9	13	0
FI	63	13	143	14	–1	IL	2.7	15	6.0	14	1
CA	96	9	135	15	–6	IT	2.6	16	4.2	15	1
ES	32	17	122	16	1	TW	0.7	19	3.8	16	3
BE	**57**	**16**	**120**	**17**	**–1**	CA	3.1	14	3.8	17	–3
TW	16	20	89	18	2	ES	0.8	18	2.6	18	0
AU	61	15	61	19	–4	AU	3.1	12	2.5	19	–7
IL	18	18	51	20	–2	CN	0.01	20	0.3	20	0

Source: EPO (PATSTAT).

1 The country of residence is determined by the first applicant listed (first-named applicant principle).

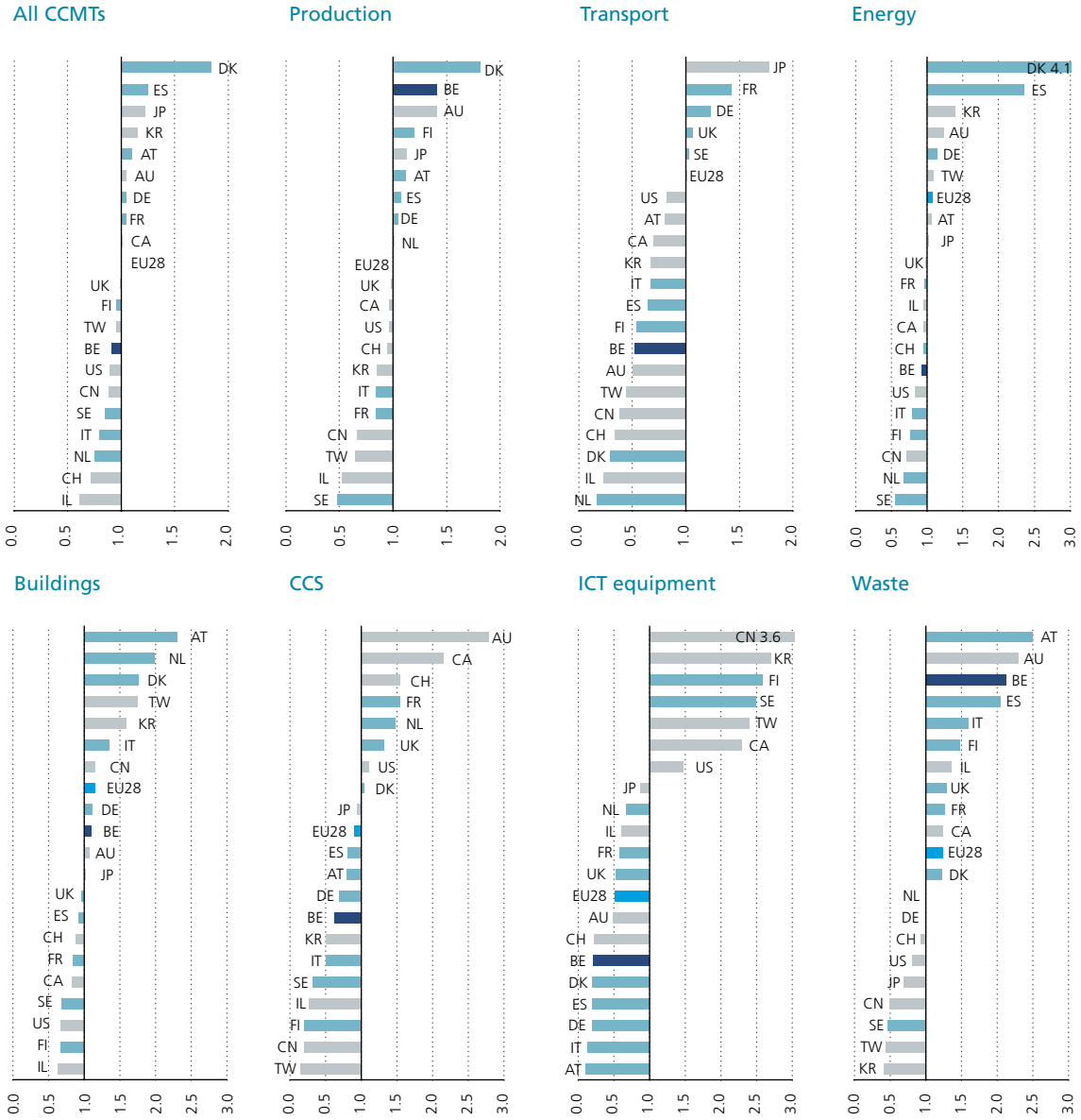
2 Aggregate data at total CCMTs level corrected for multiple counts as patents may be classified in more than one Y02i technology class.

The tax environment is also relevant to the location of companies' headquarters and research centres, as patenting tends to be carried out in countries that offer an advantageous tax system for patent activity. So, many innovative multinationals have set up their business operations in Switzerland because of the quality of its researchers and because of its competitive tax system too. With 48 CCMT patents per million inhabitants, Luxembourg is at the top within the EU28 ranking; its attractiveness is influenced by a policy of exempting patent and software income through an intellectual property box regime. By calibrating the number of patent

Chart 7

Revealed technological advantage in CCMT fields of the top 20 origins (including EU28) for patent applications filed at the EPO over the 2000-2016 period

(percentage green patents among the total patents of a country divided by the percentage green patents in total patents filed at the EPO from all countries)



Source: EPO (PATSTAT).

applications by size of the applicant country (its population), the ranking shifts in favour of these countries with special schemes and in favour of Denmark, Sweden and Finland, all three flagged up as innovation leaders within the latest European Innovation Scoreboard 2020. Austria, the Netherlands and France continue to outperform Belgium which has noticeably improved its ranking when calibrating with its population, just outside the top 10.

When considering the relative specialisation of these countries in chart 7, Denmark and Spain (albeit on a lower level) have the highest specialisation index in CCMTs. This position is strongly influenced by their specialisation in energy-related CCMTs, the technological field in which more than 50 % of their climate-related patents originate. The specialisation of non-EU28 players is the strongest in greening ICT equipment with a noticeable presence from the Asian and North American applicants. European countries with their own national car brands have a relative technological advantage in the transport field but the highest specialisation goes to Japan (as many as 40 % of Japanese green patents to the EPO are linked to transport). Belgium-based applicants have a technological advantage in CCMTs linked to (solid) waste management (only one major player with 20 % patents hold by Solvay), production processes (mainly for CCMTs relating to chemical industry – see section 3) and buildings (in technologies improving the efficiency of home appliances and heating, ventilation or air conditioning).

Moving to the individual company level, not surprisingly, the ranking is dominated by large industrial groups. Five of the top six applicants to the EPO (by number of CCMT patents) over the 2000-2016 period have filed applications linked to transport technologies. Given the contribution of transport to total GHG emissions and the emphasis that regulations put on controlling the environmental impact of transport in general, firms in the sector devote a significant part of their efforts to the development of transport-related CCMTs. The most green-patenting European companies are German firms.

CCMTs have cross-cutting applications in a wide range of industries. However, at EU level, it appears that the majority of patents are filed by companies in a limited number of branches of activity, and that these patents

Table 5

Top 6 worldwide and European applicants to the EPO – 2000-2016

(patent count in absolute numbers)

	Origin	Number of CCMT patents	Main CCMT fields[2]
Applicants from all countries[1]			
1. Siemens AG	DE	4 500	Energy – Transport – Production
2. Toyota Jidosha Co	JP	4 345	Transport[3]
3. General Electric Co	US	3 863	Energy – Transport
4. Mitsubishi Group	JP	2 851	Energy – Transport – Buildings
5. Robert Bosch GmbH	DE	2 132	Transport[3]
6. Samsung Electronics Co Ltd	KR	2 032	ICT equipment – Energy
EU28 applicants			
1. Siemens AG	DE	4 500	Energy – Transport – Production
2. Robert Bosch GmbH	DE	2 132	Transport[3]
3. Airbus – EADS	DE FR ES	1 463	Transport[3]
4. BASF AG	DE	1 132	Production – Energy
5. Vestas A/S	DK	946	Energy[3]
6. Telefon AB LM Ericsson	SE	904	ICT equipment[3]

Source: EPO (PATSTAT).

1 Entities with the same corporate name.

2 Share of patents in main CCMT fields in the company's green patent applications is larger than 20 %.

3 Share of patents in main CCMT fields in the company's green patent applications is larger than 70 %.

represent a significant part of the patent portfolio of an industry in a small number of NACE sectors. The EPO has identified 25 NACE sectors (out of 615 considered) which hold 57 % of the patents. These are mostly manufacturing industries except for crude oil extraction and power generation. This illustrates the innovation undertaken by European companies in these industries to reduce the negative impact of their economic activity on the climate (EPO and EUIPO, 2019).

3. Green innovation in Belgium

3.1 Technological fields concerned

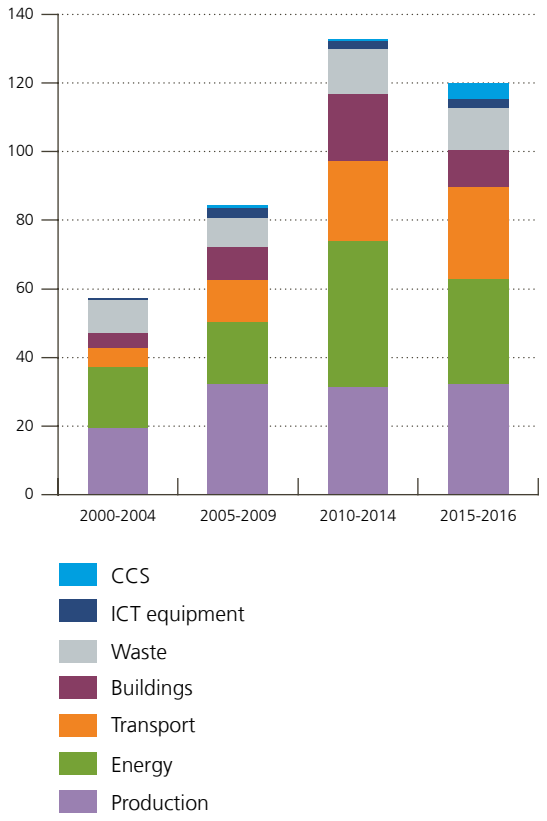
Yearly green patent filings from Belgian applicants accounted for some 120 patents in 2015-2016 and mirrored the global trend in filings rising until 2010-2012 then falling off. The largest share of patent applications is in production processes technologies and has remained stable since 2005-2009. It reflects, more generally, the specialisation of Belgian innovation in the field of specialised machinery (mechanical engineering) for the preparation of chemicals, minerals, glass and plastic products[1].

1 See Cheliout S. (2020), "Belgium's innovative capacity seen through the lens of patent data", NBB, Economic Review, December.

Chart 8

Number of patents in CCMT fields filed by Belgium-based applicants

(average yearly number of patents filed at the EPO[1])



Source: EPO (PATSTAT).

1 Aggregate data at total CCMTs level corrected for multiple counts as patents may be classified in more than one Y02i technology class.

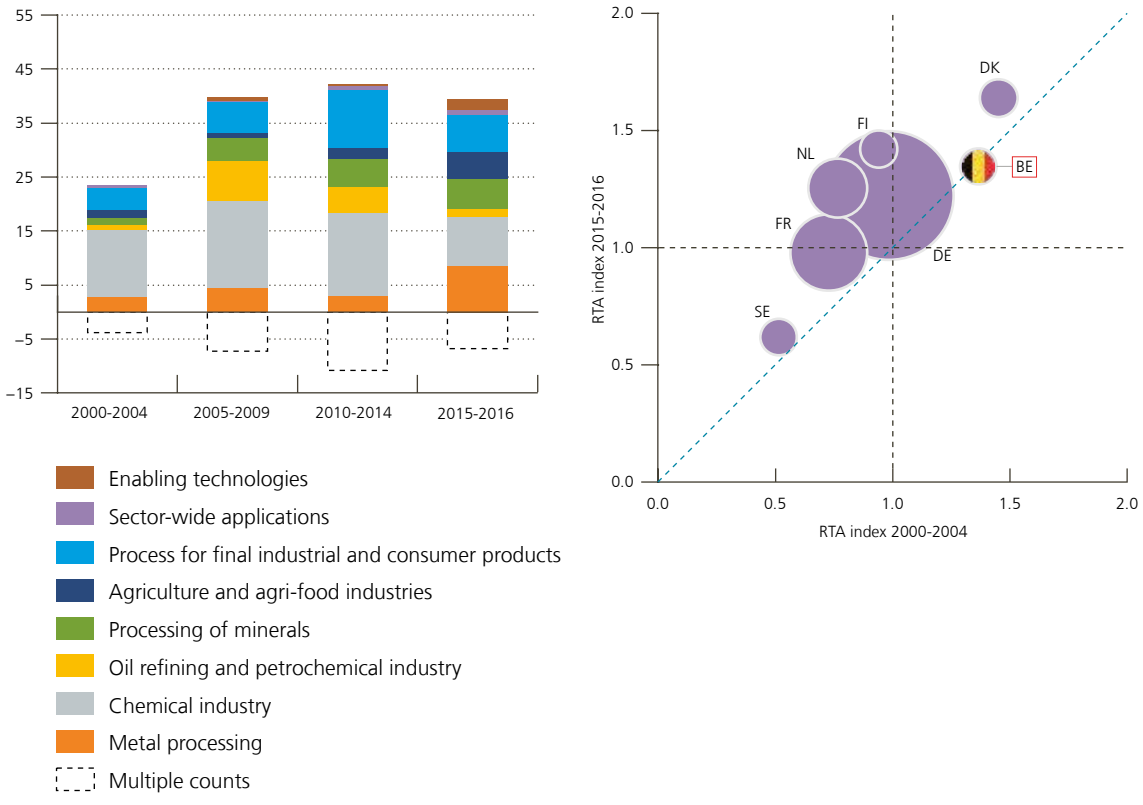
The number of applications for patents increased significantly from 2005-2009 onwards in the CCMTs relating to production processes. The patents regarding technologies of the chemicals and petrochemicals industries are predominant (some 50 % of production-related CCMT patents) and have marked this trend which may be linked to the presence in Belgium of several chemical hubs. These are mainly patent applications from companies active in the chemicals and petrochemicals sectors (Solvay and Total/Atofina research). The same applies to technologies related to the processing of mineral products with the active implication of AGC Glass Europe. Many applicants have filed rather individual patents regarding patents for processes related to agriculture and (agri-)food industries. The inter-university centre IMEC (microelectronics) is at the origin of many patents in technological fields related to the production processes of industrial or consumer products (e.g. improvement of machine tools in terms of energy efficiency, heat recovery or GHG emissions reduction) which accounts for almost 20 % of patents related to production processes.

In comparison to the three neighbouring countries and the most innovative Nordic countries in the EU28, Belgium' patenting activity is rather well specialised in greening production process equipment and it has stuck to this specialisation. Over the years, the technological advantage in chemicals and petrochemicals-related technologies has diminished (but still remains higher than one), while specialisation in green technologies related to the processing of mineral products and to the (agri-)food industries has strengthened. Belgium has almost lost its specialisation in technologies related to metal processing. Progress is also visible in comparison

Chart 9

Patents in CCMTs in the production or processing of goods

(average yearly number of patents filed at the EPO[1] and RTA index[2])



Source: EPO (PATSTAT).

1 Data regarding subdivisions (6-digit level) within one main Y02i technological class are not corrected for multiple counts (multiple counts given with a negative value for information).

2 Revealed technological advantage index: percentage green patents among the total patents of a country divided by the percentage green patents in all patents filed at the EPO. Size of the bubble proportional to the absolute number of patents on average 2015-2016 from the country in the technology field considered. RTA index above 1 signals a specialisation in the field, the higher the more specialised. Countries above (below) the 45-degree line have reinforced (reduced) their specialisation between 2000-2004 and 2015-2016.

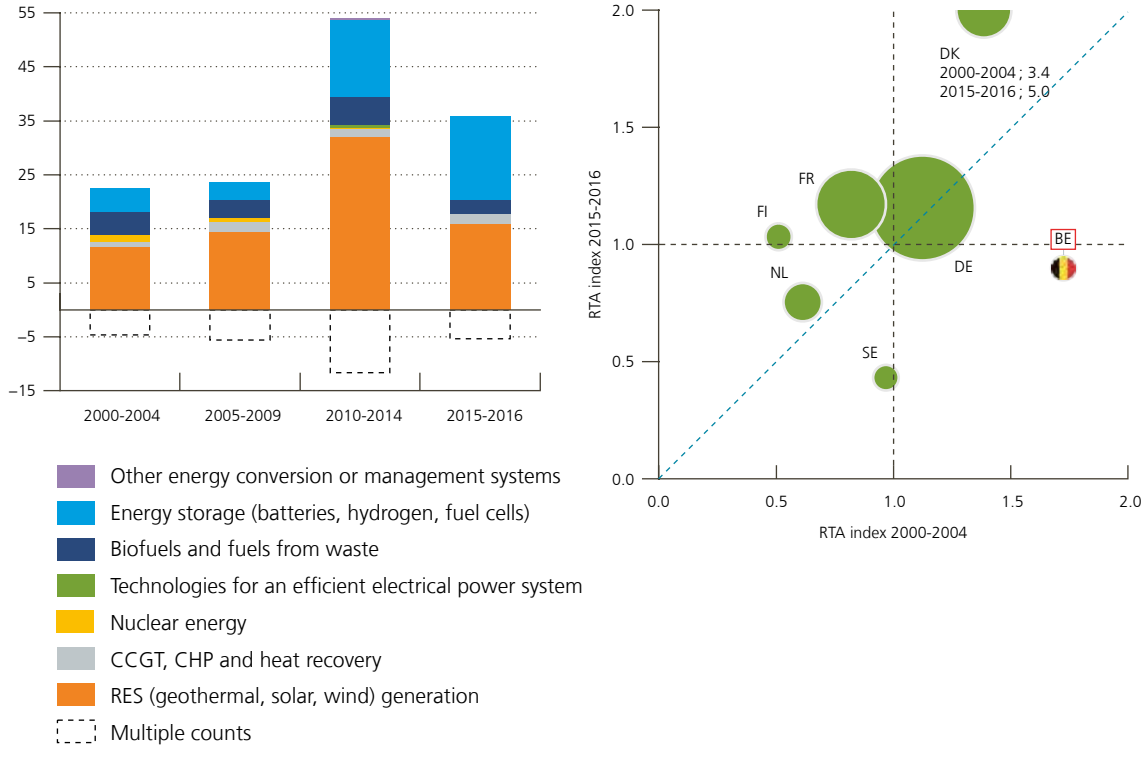
to countries where the RTA specialisation index has increased with most applications also being filed in the chemicals/petrochemicals industries technologies. Subsequently, the number of patents has risen the most in metal processing equipment (Germany, France, Finland) and in relation to production processes for final industrial or consumer products (Germany, France, Denmark).

The sustained development of patent applications in the energy-related technologies since 2005-2007 is no exception in Belgium, with filings increasing fourfold to a peak in 2011-2012, mainly for technologies related to energy production through RES which account for some 55 % of patents in the energy domain: patents in solar PV and solar thermal energy saw the strongest growth, followed by wind power. The upward trend slowed significantly after 2012. Patent applications for enabling technologies in the energy sector, which include electricity storage solutions, developed later and have not dropped off in the recent period as it has been the case for clean energy production. From 2010 on, patenting activity on battery and hydrogen technologies increased and, together with patent filings in fuel cells technologies, represented some 25 % of patent applications within the 2000-2016 period; it reached a level similar to patents filed in solar and wind technologies. Research into non-fossil fuels (biofuels and fuels from waste) has also led to regular patent applications since 2000 and it accounts for 12 % of patent applications in this field. All these developments are largely driven by the activity of a few players in the wind (ZF Wind Power Antwerpen) and solar sector (IMEC). For technologies related to biofuels and waste products, there are no key players, but rather a series of diverse smaller players.

Chart 10

Patents in CCMTs related to energy generation, transmission or distribution

(average yearly number of patents filed at the EPO[1] and RTA index[2])



Source: EPO (PATSTAT).

1 Data regarding subdivisions (6-digit level) within one main Y02i technological class are not corrected for multiple counts (multiple counts given with a negative value for information).

2 Revealed technological advantage index: percentage green patents among the total patents of a country divided by the percentage green patents in all patents filed at the EPO. Size of the bubble proportional to the absolute number of patents on average 2015-2016 from the country in the technology field considered. RTA index above 1 signals a specialisation in the field, the higher the more specialised. Countries above (below) the 45-degree line have reinforced (reduced) their specialisation between 2000-2004 and 2015-2016.

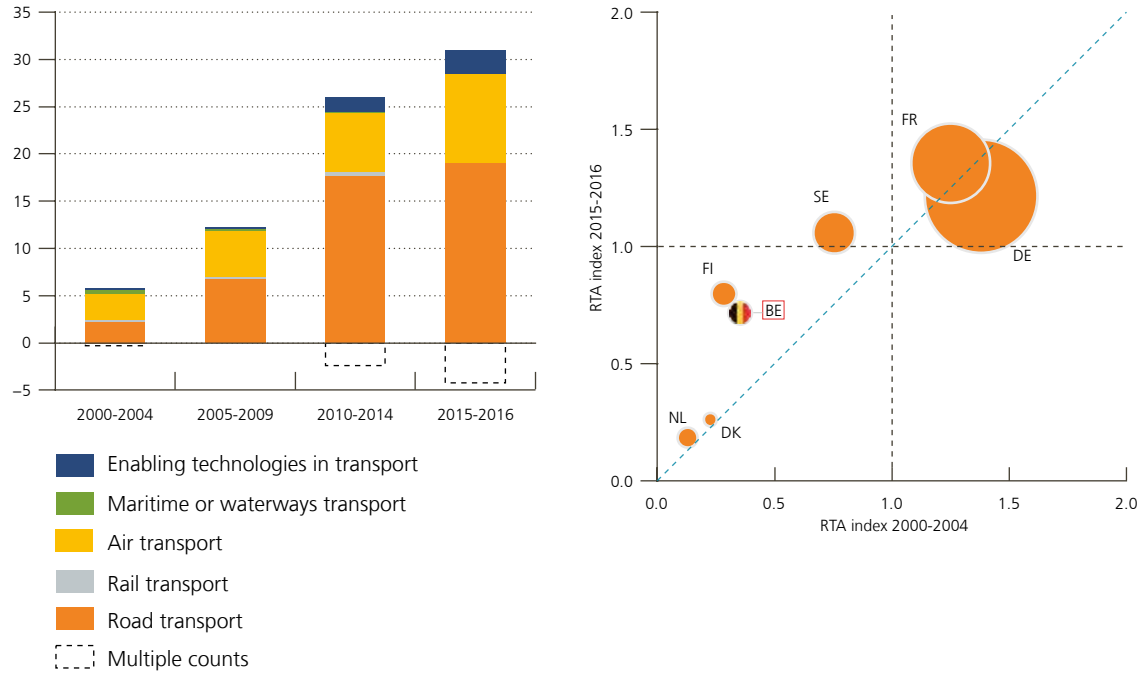
Belgium's patenting specialisation in the low-carbon energy technology fields has lost ground, while all other countries except Sweden have reinforced their specialisation with the strongest patenting activity seen in energy generation through RES. Proportionally, patenting activity in energy storage solutions is also visible in Germany, France and Finland. Like Sweden and the Netherlands, Finland holds a stronger position in patents for technologies for the production of fuel of non-fossil origin as it pursues a strong policy for developing bioenergy (mainly from forest industry by-products).

Patent filings in CCMTs relating to transport have seen continuous progress in road and air transport, with the strong involvement of one major applicant in each of the two fields: Plastic Omnium Advanced Innovation and Research (which is specialised in plastic components for the automotive industry and in fuel systems), while Safran Aero Boosters (former Techspace Aero) specialises in aeronautical and space equipment and in test cells. Some 30 % of Belgian transport-related CCMT patents filed at the EPO are for air transport applications; these include innovations on weight reduction, profiling, efficiency-enhancing electrical systems or propulsion technologies. Regarding road transport the main technologies by patent count are related to the improvement of the energy and emissions efficiency of conventional internal combustion engines which represent some 43 % of transport-related patents filed between 2000 and 2016. Patents on technologies related to hybrid and EVs have mainly been filed since 2009-2010 and are four times lower than for conventional vehicles. This observation that most of the efforts and investment made are still (and mainly) dedicated to the development of technologies improving the efficiency of internal combustion engines is shared at European level. Further innovative progress

Chart 11

Patents in CCMTs related to transport

(average yearly number of patents filed at the EPO[1] and RTA index[2])



Source: EPO (PATSTAT).

1 Data regarding subdivisions (6-digit level) within one main Y02i technological class are not corrected for multiple counts (multiple counts given with a negative value for information).

2 Revealed technological advantage index: percentage green patents among the total patents of a country divided by the percentage green patents in all patents filed at the EPO. Size of the bubble proportional to the absolute number of patents on average 2015-2016 from the country in the technology field considered. RTA index above 1 signals a specialisation in the field, the higher the more specialised. Countries above (below) the 45-degree line have reinforced (reduced) their specialisation between 2000-2004 and 2015-2016.

is needed to lower the environmental footprint of transport in the short- to medium term and develop novel technologies for electric energy production and storage in transport equipment (Hernández, 2020).

Patent filings in CCMTs in transport are a German and French specialisation through the research activity of their respective car and aircraft manufacturers – but not exclusively as Robert Bosch and Siemens also feature among the large patenters in Germany as does Valeo in France. In other countries, patent activity is more concentrated among equipment manufacturers for the automotive and aviation sectors. Since 2009-2010, a more significant activity has been emerging around enabling technologies in transport like equipment needed for EVs or transport applications of fuel cell and hydrogen technologies.

3.2 Who is involved in green patenting in Belgium?

From the ranking of Belgium-based applicants according to their annual number of green patents, it appears that the leading ten patent applicants over the period 2000-2016 together account for 47 % of CCMT patent applications. The rich information found in patent documents helps to get a more detailed picture of whether the patent's owners are companies, individuals or universities and research organisations. So, behind the Belgian leader Solvay, international companies with research centres in Belgium, public research organisations and universities complete the ranking. This rather concentrated nature of patenting in CCMTs is also identified at the global – Belgian – level and coincides with similar findings regarding the Belgian innovation fabric and R&D expenditure[1]. When considering patent activity in a narrow framework like here, one has to remember that there are other means for protecting inventions. Some companies prefer to keep industrial secrecy rather than file for patents, something which is clearly not captured in the patent statistics.

When considering the main CCMT fields to which their patents relate, it appears that companies intensify the green nature of their inventions in technologies linked to their main business or flagship products: seven out of ten companies in this ranking have filed patent applications in a technological field directly related to their core business (i.e. more than 75 % of their CCMT patents fall in the same technological field). Solvay, AGC Glass Europe and Umicore have a slightly more diversified patent portfolio although still linked to their main product line: chemical applications to energy storage (fuel cells) and PV cells, glass (materials) technologies for solar PV or battery technologies. The involvement of innovative companies active in different domains provides key channels for the diffusion and further valorisation of inventions across the board.

Research organisations and universities within the top ranking together hold 184 patents, slightly more than first-ranked applicant Solvay. Behind providing qualified human capital, universities and research organisations are at the root of basic research and scientific knowledge and patenting is a major tool for the valorisation of their discoveries: their developed patents can be licensed or used to help create or finance spin-off companies. Those applicants can therefore derive value from the patent even if they are unable to directly manufacture the products and results of their research. In addition, patenting by universities allows technology transfers from research to industries; it gives a framework to collaborative research with industries and ensures the required protection for investors to bring inventions to the markets.

All Belgian universities and research organisations filed some 13 % of CCMT patents registered within the 2000-2016 period. This share is slightly higher in comparison to the total patent portfolio where Belgian universities (patents owned or co-owned by university applicants) hold 11.2 % of patents filed at the EPO in the same period which is already a high share compared to other European countries[2].

1 See Vennix S. (2019).

2 It should be noted that statistics on the relative importance of universities in patenting activity in Belgium and in other European countries are influenced by the respective intellectual property regimes. Typically, inventions by researchers and academics may not all be patented under the university's name but rather fall under the category of individual inventor. But even when limiting to the 2006-2016 period, Belgian universities exhibit a higher share of ownership of patent applications at the EPO (see Cheliout S. (2020)).

Table 6

Top Belgian applicants of CCMT patents at the EPO over the period 2000-2016 [1]

(CCMT patent portfolio in absolute number [2] and in % of total CCMT patents)

Company – institution [3]	Number of patents 2000-2016	In % of total CCMT patents	Main CCMT fields [4]
1. Solvay	176	10.9	Production – Energy
2. Total Petrochemicals Research – Atofina Research	114	7.1	Production [5]
3. Plastic Omnium Advanced Innovation & Research – Inergy Automotive Systems	113	7.0	Transport [5]
4. IMEC	73	4.5	Energy
5. Safran Aero Boosters SA – Techspace Aero	72	4.5	Transport [5]
6. Electrolux Home Products Corporation	56	3.5	Buildings [5]
7. AGC Glass Europe	44	2.7	Production – Energy
8. VITO	40	2.5	Energy
9. Umicore – Union minière	39	2.4	Production – Energy
10. ZF Wind Power Antwerpen	38	2.3	Energy [5]
First 10 applicants	769	47.4	
11. Agfa Gevaert NV	35	2.2	Energy [5]
12. Katholieke Universiteit Leuven	32	1.8	Energy – Production
13. Universiteit Gent	24	1.5	Production – Energy
14. Cockerill Maintenance & Ingénierie	16	1.0	Energy [5]
15. Université de Liège	15	0.9	Energy – Production
Belgian applicants at the EPO	1 613	100.0	Total CCMT

Source: EPO (PATSTAT).

1 Ranking of the main consolidated applicants at the EPO (first-named applicant principle). It is based on direct and Euro-PCT applications filed with the EPO during the reporting period.

2 Aggregate data at total CCMTs level corrected for multiple counts as patents may be classified in more than one Y02i technology class.

3 Entities with the same corporate name unless otherwise stated. Institution refer to universities and research organisations (with grey background). IMEC: *Interuniversity Microelectronics Centre*, VITO: *Vlaamse Instelling voor Technologisch Onderzoek*.

4 Share of patents in the main CCMT fields in a company's or institution's green patent applications is larger than 30 %.

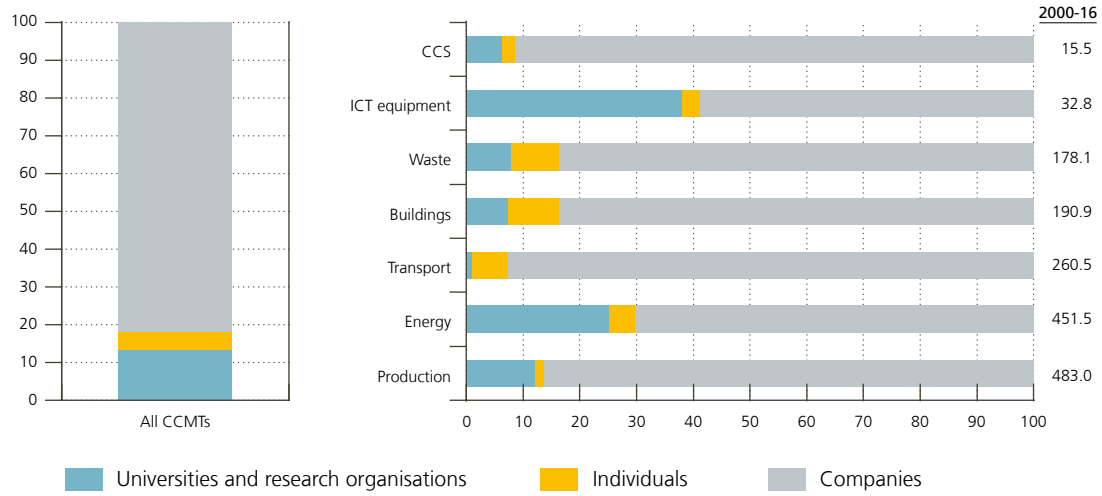
5 Share of patents in the main CCMT fields in a company's or institution's green patent applications is larger than 75 %.

Within the various CCMT fields, universities and research organisations hold almost 40 % of patents in CCMTs related to ICT equipment (but for a rather small number of patents, almost one-third of which have been filed by IMEC). The higher patenting activity in energy-related CCMTs by universities (25 % of total applications in the field) is dedicated to solar PV (60 % and this by two-thirds by IMEC) and to energy storage solutions (with strong involvement from VITO). Patented inventions in production processes are more distributed among (Flemish) universities and research organisations: first in the process for final industrial or consumer products (improving processes or mechanical equipment, where IMEC is particularly active) and second in CCMTs for the preparation of chemicals (Ghent university). VITO is the main applicant in CCMTs in buildings (efficient end-user-side electric power management and consumption, including domotics) and in waste management (in particular for wastewater treatment) but with less than six patents in each domain. The patents in transport developed by research institutions (already marginal in number) are filed for three inventions relating to EVs (which contrasts with the main patenting in the field relating to improvements to conventional internal combustion engines). Patent applications in transport are largely driven by (two) companies as is the case for CCS.

Chart 12

Structure of Belgian CCMT patent ownership

(patent applications[1] by type of filing entity in % and by number, 2000-2016)



Source: EPO (PATSTAT).

1 Aggregate data at total CCMTs level corrected for multiple counts as patents may be classified in more than one Y02i technology class.

4. Beyond environmental innovation

4.1 Technological innovation is key to achieving carbon neutrality but not enough in itself

A recent IEA survey (IEA, 2020) on the level of technical development of some 400 clean energy technologies reveals that 75 % of the cumulative CO_2 emission reductions needed to move to a sustainable path are based on technologies that are not sufficiently developed: about 35 % come from technologies that are currently at the prototype (18 %) or demonstration (18 %) stage and another 40 % of the reductions are based on technologies that are not yet widely commercialised. Efforts to accelerate innovation are therefore urgently needed even in mature technology fields where follow-up innovations are still highly relevant.

Beyond that, innovation must be disseminated through technology acquisition – an essential but time-consuming process. Economic history shows how slow the wide-scale diffusion of disruptive production processes like steam power or electrification has been. Broad adoption of new clean energy technologies may take decades to go from prototype to market introduction (even in the most active areas) and from market introduction to global diffusion: it took almost three decades to develop li-ion battery-powered EVs and solar PV, almost two decades for wind and nuclear power and even ten years to develop LED lights. Six more years were needed to reach a 1 % share of nuclear electricity supply or EVs in the light duty vehicle stock. For a 1 % share of wind electricity in total generation or of LEDs in the lighting equipment stock, it took an extra decade and a further 25 years for solar PV to achieve a 1 % share in electricity generation (IEA, 2020b). Just as climate change knows no borders, the dissemination and uptake of low-carbon solutions must also extend to all countries, which further amplifies the need to improve the diffusion of innovation on a worldwide scale. A global approach and joint commitment to international research and innovation can further accelerate the development of innovative technologies. As the global warming clock is ticking, strong action will be needed to achieve their diffusion at unprecedented speed.

This is already an issue for today's investors as the level of future emissions will be driven by the next investment cycles which tend to be in the 20-25-years range for some energy technologies. This means that some large infrastructure that is installed today often has a life span up to and beyond 2050. Decisions on investment today therefore affect the ability to meet climate targets not only in 2030 but also 2050 and beyond. It is important not to get locked in infrastructure whose use is carbon-intensive and at least to have the technical feasibility of adapting the equipment.

4.2 Innovation has to materialise

Environmental innovation must materialise in new low-carbon products and infrastructure, turning the results of the innovation effort into sustainable solutions made quickly available on a large scale to all stakeholders.

Public authorities have a role to play in this process. The entire production fabric benefits from spillover effects of different types of research networks (collaborative research, thematic knowledge clusters, public-private partnerships) linking together university expertise, basic research and applied research. Hence, there is a strong rationale for government policy support to R&D and innovation activity in order to address the market failure associated with knowledge innovation that may spill over to other firms without having to bear the full R&D costs. Dechezleprêtre *et al.* (2017) found evidence that the knowledge spillovers from patents for low-carbon technologies are among the highest: in the electricity and transport sectors, clean patented inventions are cited 43 % more than inventions in (dirty) conventional technologies and the magnitude of knowledge spillovers is comparable to IT. Such large spillovers can provide motivation for public funding of R&D as private stakeholders may be cautious about investing in these fields due to knowledge externalities that might be particularly high for some CCMTs. Focusing on low-carbon innovation would further enhance economic growth.

Public policy measures go beyond providing education and supporting knowledge and scientific research. Many and varied instruments are available to set up a favourable environment for innovation behind the (structural) funding of research centres (as is the case with IMEC and VITO) or implementing clusters and business networks around technological solutions for the energy and climate transition, fostering science and industry interactions. On the business side, new market designs and operational practices are needed to facilitate the deployment of all options like the marketing of decentralised electricity production or shared mobility. New forms of financing and investment are being developed, like crowdfunding, private-public partnerships and third-party investment formulas, all of which require at least an open mindset from the authorities and an effective regulatory framework. The implementation of a low-regulation framework (regulatory sandbox) which temporarily restricts regulations (like the Flemish green innovation space – *groene innovatie ruimte* – which is targeted at businesses and research institutions) facilitates further upscaling of small-scale demonstration projects in a real-life environment.

Besides technological innovation in itself, sufficient attention has to be paid to social innovations that will support changes in habits and (energy) consumption modes like shared mobility solutions or grouped housing. The dissemination of knowledge through education, advice and awareness campaigns will help to gain the support of citizens and communities to apply the research and innovation results so that new sustainable solutions are deployed and really matter to people.

Finally, the marketing of products developed on the basis of CCMTs is likewise a driver of sustainable economic growth. Some information on the economic importance of activities linked to environmental protection and less fossil energy use in Belgium can be found in the environmental economic accounts drawn up by the Federal Planning Bureau. These satellite accounts of the national accounts cover the activities of the environmental goods and services sector which consists of producers of goods and services relevant to environmental protection and natural resource management. It concerns such things as waste and wastewater management, the production of renewable energy, more efficient use of energy and heat savings (insulation work), and activities

aimed at reducing the use of fossil energy sources as raw materials. Some 10 500 companies are identified as being suppliers of environmental goods and services in Belgium and 97 % of them employ less than 20 workers. Firms involved in waste and wastewater management and in the management of energy sources have generated around 0.8 % of the gross value added created by market activities. Their market output corresponds to roughly 1.3 % of Belgian production. Their exports also brought in almost € 2.7 billion on average between 2014 and 2018, representing 0.8 % of Belgian exports. This gives only a very partial idea of the importance of these activities : the (possibly innovative) products to which they relate are the result of global and not exclusively domestic research and not all CCMTs are included in this overview.

In order to capture the benefits of R&D, innovation needs to be diffused within the economic fabric across national borders. In a global market, the cost of technological deployment can come down quickly through economies of scale. To harness the potential of the global market, cross-border trade and investment in low-carbon goods, services and technologies need to be encouraged and scaled up. Stimulating low-carbon trade will create virtuous cycles, providing further investment opportunities and expanding the market for key technologies.

Conclusion

Building on patent data as a measure for green innovation, we provide an analysis on its origin and field of application over the period from 2000 to 2016. The CCMTs relate to seven domains into which they are categorised, such as energy, transport or building-related technologies. The worldwide inventive activity around these technologies has steadily increased since 2005 to a peak in 2012 and has since stabilised or even declined. Several technologies of growing importance for the environmental transition (like batteries) have maintained or even raised their patent numbers. Patents on CCMTs now account for 9 % of the world's inventions, up from 4 % in 1990-1994. This activity is mainly carried out by inventors from the United States, the EU28 and Japan up to 23 % each of the patents filed. There is also a noticeable emerging inventive activity from Chinese and Korean inventors, who now account for 22 % of all CCMT patents worldwide.

At the level of the European market, the majority of green patents filed with the EPO are held by European players. However, the commercial attractiveness of this market can also be gauged in the patent applications filed by non-European players wishing to protect their inventions. As far as EU patent applicants are concerned, 75 % of these come from five European countries, of which Germany largely dominates, followed by France. In fact, four of the six European companies with the most patents are of German origin. Over the period 2000-2016, Belgium has maintained its position in the ranking of countries by CCMT patent number.

A detailed analysis of the portfolio of CCMT patents filed by Belgium-based players by technological field – which represents some 1 600 patents for the 2000-2016 period – shows that where patent applications are generally more important in the green technologies linked to energy and transport, the positioning of Belgium differs : patenting activity in Belgium primarily concerns technologies linked to production processes, which coincides with an observation already made elsewhere that Belgian innovation activity as a whole is geared towards specialised machinery. The relative specialisation reflected in the relative technological advantage index (the percentage of green patents in the total Belgian patent portfolio compared with this same proportion in all patents submitted to the EPO) in this field persists. In the energy-related technological fields, patent applications pertain mostly to technologies related to RES and, more recently, to energy storage solutions. Despite these new developments, Belgium's patenting specialisation in the energy technology fields has lost ground. In the transport-related fields, most patent applications concern road and air transport equipment, almost exclusively by a single company in each sector. Low-carbon patent applications of Belgian origin are most visible in technologies related to the chemicals industry, solar power, solid waste management, energy storage and conventional internal combustion vehicle.

When considering the individual Belgian patent owners, research efforts are found to be in the hands of a small number of players (as is the case at global level): the top ten Belgian patent holders have 47 % of CCMT patents in their portfolio. Innovative Belgian and international companies with research centres in Belgium dominate this ranking. The noticeable presence of universities and research centres already observed at the level of the Belgian innovation ecosystem as a whole is even more visible at the level of CCMTs: 13 % of CCMT patents applied for the 2000-2016 period were at their initiative, compared with 11.2 % for all Belgian patent applications filed by these research establishments.

Further technological advances are still needed to achieve carbon neutrality. Moreover, successful innovation outcomes have to materialise, turning the results of the innovation effort into sustainable solutions made quickly available on a large scale across national borders too. The opportunity is given to couple environmental transition with economic stimulus by expanding markets for low-energy products and components and implementing green production processes. This time-consuming process makes it all the more necessary to push technological uptake at the fastest possible rate.

Appendix

Some concepts around patenting used in this article

Patenting can take different routes:

- an inventor first has to file an application with a **national** patent office which is generally the national office of the applicant's (the future owner) country. After examination, the patent may be granted and enforced only in this country in accordance with its national law and national patent office rules. The application can be filed with several national offices;

- the patent application may be filed at a **regional** office (like the European Patent Office) which than provides protection in the member states of the regional office (as a bundle of patents at national level or a regional patent that provides protection in the entire region);

- the applicant may file a single **international** application with national or some regional patent offices of the Patent Cooperation Treaty (PCT) contracting states or directly at the international office of the World Intellectual Property Organisation. It will have the same effect as direct application at national or regional offices of PCT contracting member states. The bulk of the patent application procedure is carried out at international level, but the patent itself is granted by each designated state within the subsequent national phase.

In this article, we consider single patent applications directly filed at the EPO (as a bundle of national patents to be validated by the respective national offices) and Euro-PCT applications, i.e. international applications for which the EPO is a designated office: the patent has been accorded international filing date with the effect of a regular European application and validation by the national patent offices.

Reference dates for a typical patent:

- priority filing date: when the applicant first files the application – generally in the country of residence. It is the closest date to the research activity and invention;

- application date: within a 12 months legal delay the applicant may eventually apply for protection in other countries;

- publication date: the application is published at least 18 months after the 'priority date'.

Reference country:

- inventor's country to evaluate a country's inventive performance;

- applicant's country to evaluate a country's innovative performance.

Measure based on patent counts: simple versus fractional count of patents. A unique patent may have many different applicants/inventors located in different countries and may be relevant for different technological fields. If there is more than one applicant/inventor, the number of patents is divided equally amongst all of them and their corresponding country of residence (fractional count) to avoid multiple counts in establishing the geographic origin. The same rule applies if a patent is relevant for different technological fields.

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Getting fiscal policy in shape to swing with monetary policy

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Introduction

When the Covid-19 shock hit, central banks and governments successfully managed to stabilize the macro-economy and this despite going into the crisis with relatively limited policy space. Looking ahead, however, the question rises whether they will be able to do so again in case of a negative shock, given structurally low interest rates and higher government debt.

With the low interest rate environment likely to persist, monetary policy's potential to provide extra support to the economy through its policy rate instrument and even through its unconventional tools (like asset purchases) appears limited going forward. This implies that fiscal policy may be more frequently called upon to actively contribute to business cycle stabilisation, and especially so during downturns. However, in many countries, including in the euro area, government debt ratios have increased significantly in 2020 reaching decades-long highs and in several countries debt paths are set to climb further. That reduces the fiscal policy space that might be needed to address the next downturn and increases the risk of disruptive (self-fulfilling) debt crises.

Where government debt levels are high and rising and when circumstances allow it, attention should thus shift back to rebuilding fiscal buffers. How can this be achieved? A logical avenue to pursue entails fiscal consolidation. Some[1] plead for patience and dispute the need for a return to "austerity", arguing that favourable interest rate and economic growth developments make high debt levels more sustainable and will go a long way in stabilizing the debt ratios. Other voices are more extreme[2], advocating that central banks should cancel the government debt – acquired through asset purchase programmes – on their balance sheets. This article takes a closer look at the different options to bring government debt dynamics under control.

Throughout the article, we assume that the structurally low interest rate environment persists, so that monetary space is expected to remain constrained. This does not imply that monetary policy is out of the picture. Rather on the contrary, monetary policy is key in enhancing the effectiveness of fiscal policy in macro-economic stabilisation (in case of large shocks) and it has a significant impact on government debt dynamics.

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1 See for instance an interview of the OECD's Chief Economist, Laurence Boone, with the Financial Times on 4 January 2021 'OECD warns governments to rethink constraints on public spending' and Lorenzo Codogno and Giancarlo Corsetti VoxEU column "Post-pandemic debt sustainability in the EU / euro area: This time may (and should) be different" published on 18 September 2020.

2 See the open letter "Cancel the public debt held by the ECB and 'take back control' of our destiny" published on 5 February 2021 in several newspapers.

To set the scene, the article starts with a concise overview of economic thinking about monetary and fiscal policies' role in macro-economic stabilisation, highlighting the nuances that the great financial crisis and subsequent persistent low interest rate environment have brought to the framework. The next chapter applies theory to practice. Looking back, it illustrates that the prescription of complementary monetary and fiscal measures proved effective in tackling the COVID-19 crisis but, going forward, it also stresses the need to restore policy space when circumstances allow this. As the article focuses on how to build back fiscal buffers, the third and central chapter evaluates the potential of different options to bring high and rising government debt levels under control. Conventional avenues considered include low interest rates, higher economic growth rates, somewhat higher inflation and fiscal consolidation. Note that for all debt dynamic simulations Belgian data are used. The unconventional proposal of cancelling the government debt on the central bank balance sheet, is also critically assessed; the analysis here remains purely conceptual however. The main findings are that despite favourable interest-rate-growth differentials, fiscal efforts and/or structural reforms will be needed to bring high government debt ratios on a downward path and that debt cancellation won't do the trick.

1. Thinking about fiscal and monetary interactions has evolved in recent years

The great financial crisis and subsequent persistent, low growth, low inflation and low interest rate environment have led to a rethink about monetary and fiscal policies' role in macroeconomic stabilisation. The traditional framework still applies in normal times, but when interest rates are at or close to their lower bound, a refined framework enters into force[1].

1.1 The traditional view: a clear-cut assignment

Prior to the great financial crisis, the macroeconomic consensus was that monetary and fiscal policies ought to operate largely independently from each other. They each had their own objectives and specific instruments to meet these objectives. Through its policy-rate-setting, monetary policy was responsible for price stability and, in doing so, actively contributed to macroeconomic stabilisation. In exceptional circumstances, the monetary authority would also step in as lender of last resort to ensure the smooth functioning of financial markets. Fiscal policy was not assigned an active role in business cycle stabilisation; it mainly ought to let automatic stabilisers play freely. Fiscal policy had instead a bigger role to play in the optimal allocation of available resources and a fair distribution of income and wealth, through which it ought to contribute to structural issues like higher productivity growth and durable and equitable economic growth. It should be noted, though, that the complementarity between structural policy and macroeconomic stabilisation was not well acknowledged. Over the longer term, fiscal policy's main guiding principle was to keep government debt sustainable. The EU Treaties, for instance, enshrined government debt and deficit rules in law.

The framework's strict division of tasks between monetary and fiscal policies primarily intended to avoid entering a regime in which excessive government deficits would bring about excessively high inflation.

1.2 Refinement: at the lower bound, it takes two to make a thing go right

Over the past decade, the economic landscape has changed, however, bringing with it new policy challenges for which the traditional framework was not particularly equipped. More specifically, the low natural rate of

1 See for example Bartsch *et al.* (2020) for a detailed analysis and recommendations on the policy mix and Butzen *et al.* (2017) for the policy mix applied to the euro area.

interest hampers monetary policy in stabilising the macroeconomy: once policy rates are at or near their lower bound, the central bank can no longer use its traditional instrument to stimulate inflation and the economy at large[1]. Consequently, at the lower bound, complementary monetary and fiscal policies are needed for effective macroeconomic stabilisation to still take place, especially when the economy is in a recession.

This implies, on the one hand, that fiscal policy has a bigger role to play in stabilising the business cycle. For one, a discretionary fiscal expansion reduces the need to push interest rates far below the natural rate thereby helping monetary policy in lifting economic activity and, consequently, inflation. Second, even when private spending does not react immediately, a deficit-financed fiscal stimulus – when perceived as not being backed by future primary budget surpluses – could induce economic agents to revise their inflation expectations upward, thereby helping the central bank to escape a low-inflation trap. Beyond macroeconomic stabilisation, government policies could also aid in raising the natural rate through fostering productivity growth, lowering incentives to save and encouraging investment. This would create durable policy space for the monetary authority.

On the other hand, monetary policy has proved to not be powerless at the lower bound. Through the use of unconventional instruments, like central bank asset purchases and forward guidance, it has been able to lower longer-term interest rates, thereby supporting economic activity and inflation. With a very low and flat yield curve though, the scope of these unconventional instruments to provide additional support for private spending diminishes, but they can still facilitate fiscal stimulus. Central bank asset purchases, for instance, can keep governments' borrowing costs favourable even when public debt is already high, while monetary policy's patience in withdrawing stimulus when at the lower bound, makes a given fiscal stimulus more effective than in normal times (i.e. fiscal multipliers are higher as there is no crowding-out).

This refinement to the traditional framework illustrates that effective macroeconomic stabilisation can work even in a lower bound environment, but it is not a given: it remains more precarious compared to normal times, as implementing complementary fiscal and monetary measures that create policy space for one another is not evident.

1.3 Complications

One hindrance that could arise, is the lack of fiscal space. Especially when government debt levels are already very high and increasing, the fiscal authority's room for stimulus spending may be limited.[2] In recent years, however, favourable interest-rate-growth differentials have attenuated this concern. In many countries, the interest rate on government debt has been below the economy's growth rate (r-g < 0), contributing to favourable debt dynamics (and this even more so for heavily indebted governments) as even in the presence of budget deficits the debt ratio is converging to a stable level[3]. This notwithstanding, the favourable r-g relationship is fragile: it can quickly turn due to changes in future interest and growth rates, e.g. because a high (and growing) government debt stock can raise concerns among financial market participants (driving up the risk premium). A positive r-g differential would push high debt-to-GDP ratios onto an explosive path, requiring the fiscal authority to run high primary surpluses to bring debt dynamics back under control. In such a scenario, the fiscal authority has little or no room to aid monetary policy in stabilising the economy.

Another obstacle, pertaining particularly to the institutional set-up of the euro area, is that one authority is responsible for monetary policy at the union level (that is, the Governing Council of the ECB, with representatives from the ECB Executive Board and the national central banks) while fiscal policy is set at the national level by nineteen governments. This complicates aligning monetary and fiscal policies in such a way that an appropriate aggregate fiscal stance and effective national stabilisation are simultaneously ensured, without jeopardising fiscal sustainability at the national level.

1 See for instance De Backer and Wauters (2017) for a deeper analysis of the low interest rate environment.

2 In this issue of the Economic Review, Buysse *et al.* (2021) discuss the rise in public (and corporate) debt since the global financial crisis and the risks associated with it.

3 See for example Cornille *et al.* (2019).

2. Fiscal and monetary policies were successful in tackling the pandemic but effective macroeconomic stabilisation in the future looks challenging

On the eve of the pandemic, policy space appeared rather limited. In the euro area, the monetary stance was already very accommodative with policy rates standing at record low levels and unconventional instruments, like asset purchases, already being activated. In addition, government debt levels in many Member States were at a high level, despite a gradual reduction in recent years. Nevertheless, fiscal and monetary policies in the euro area and elsewhere managed to react forcefully in response to the COVID-19 crisis. In line with the insight gained from the refined framework, the complementarity of the measures ensured their effectiveness. Looking ahead, however, policy space for macroeconomic stabilisation in case of a new negative shock appears even more limited than in early 2020 as structural impediments are likely to remain present.

2.1 Complementarity in action [1]

Given the nature of the shock the pandemic has brought, governments have been, and still are, at the forefront of the fight against COVID-19 and its economic fallout. Within its primary objective of maintaining price stability, monetary policy has played second fiddle in supporting economic activity and has focused on maintaining favourable financing conditions for all economic agents, including governments, thereby facilitating fiscal spending.

An important measure in this respect were central bank asset purchases. In the euro area, the Eurosystem stepped up its asset purchases and launched a new Pandemic Emergency Purchase Programme. The latter's flexibility enabled the Eurosystem to mitigate both common stress and fragmentation pressures in euro area sovereign bond markets and thus ensured that low borrowing costs remained in place and were shared evenly across all Member States. This ensured that all nineteen fiscal authorities could let their automatic stabilisers work freely and take supplementary discretionary stimulus measures without the surge in debt issuance pushing up government bond yields. Fiscal stimulus was therefore able to make up for the limited monetary policy space.

With respect to liquidity provision to households and firms, monetary and fiscal measures also complemented each other. Through a new series of longer-term refinancing operations, the Eurosystem has provided the banking sector with ample liquidity. In turn, governments' credit guarantees have reinforced banks' incentives to lend to the private sector.

In sum, it is the complementary nature of monetary and fiscal policies that made a sizeable stimulus possible and effective.

2.2 Future policy space is limited

In the short term, continued fiscal and monetary support in the euro area is appropriate as the pandemic continues to suppress economic activity and inflationary pressures are expected to remain muted. Looking further ahead, once the pandemic is under control and the economic recovery is on a sustainable track, the policy focus should shift to restoring policy space in order for monetary and fiscal policies to be able to effectively absorb and counter negative shocks, including tail events, in the future. Building up policy space again will not be easy though as constraints on monetary and fiscal stimulus are expected to be rather persistent (see chart 1).

1 For a detailed overview of the Eurosystem's response to the pandemic, see Boeckx *et al.* (2020).

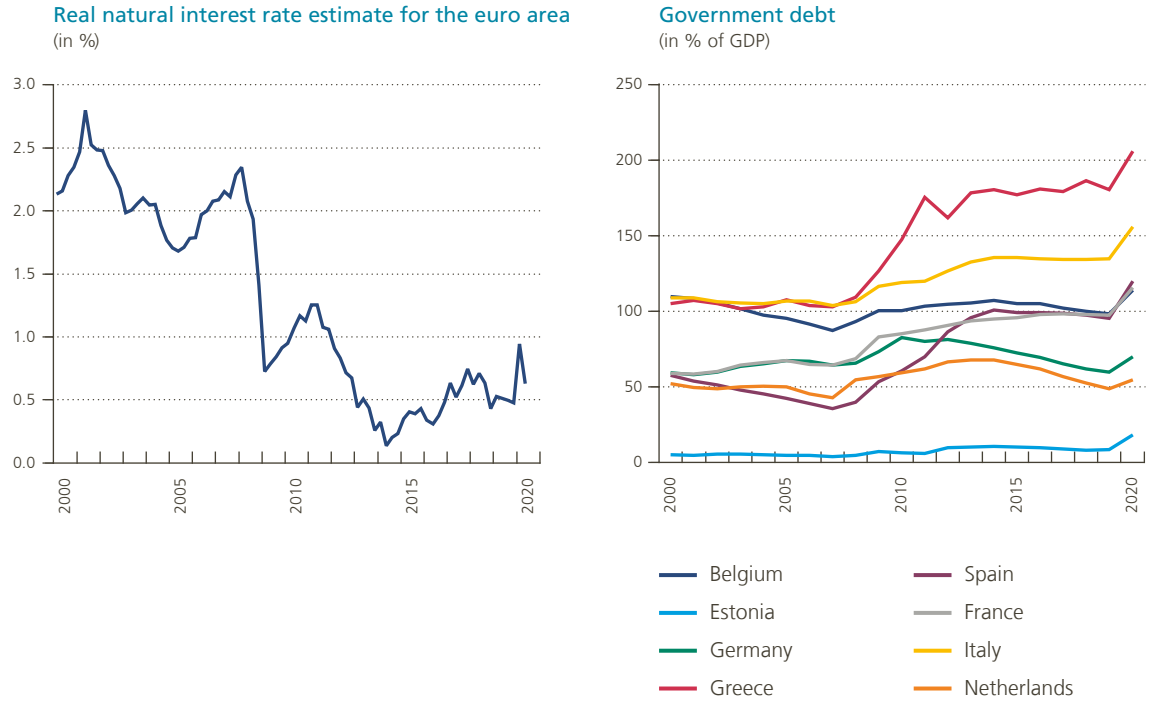
On the one hand, the natural rate of interest is expected to remain low in a post-pandemic world as the factors that have been holding it down (like population ageing and rising inequality) are not likely to quickly disappear. Certain developments – like investment in the green transition, a reversal of demographic trends and a retreat from globalisation (Goodhart and Pradhan, 2020) – could provide upward pressures though. Also note, that based on historical data, Jordà *et al.* (2020) have found that the real natural rate tends to decline by 1.5 percentage points over the 20 years following a pandemic. Overall, this would imply that monetary policy's stabilisation role will remain limited going forward, naturally lending a bigger role to governments to deal with adverse macroeconomic shocks.

In countries with low and moderate government debt levels, fiscal policy has room to complement monetary policy in macroeconomic stabilisation when necessary. However, countries with weaker fiscal positions may encounter difficulties in swiftly providing a sizeable stimulus injection in response to an exceptional shock. The COVID-19 crisis has again illustrated how suddenly fiscal positions might deteriorate: government debt in the euro area increased by 14 percentage points in 2020, with Cyprus, Greece, Italy and Spain registering surges of between 21 and 25 percentage points. In seven Member States (including Belgium) government debt exceeded 100 % of GDP by the end of 2020. For these countries, the potential to use countercyclical fiscal measures will to a large extent depend on their commitment to put government debt again on a downward trajectory going forward.

The credibility of current and future fiscal and monetary policies is actually key for effective macroeconomic stabilisation. A fiscal authority committed to debt sustainability and a central bank committed to price stability should be able to create policy space for each other, even when room for manoeuvre appears limited at first sight. Moreover, credible policies not only better prepare for bad times, but also for good times. Consider a government that has, post pandemic, been serious about bringing its high debt on a sustainable path.

Chart 1

The low natural interest rate and high debt levels in many Member States limit future monetary and fiscal policy space



Sources: Eurostat, Holston, Laubach and Williams (2017).

If inflation developments would then call for a normalisation of monetary policy, the central bank will be able to act according to its price stability mandate instead of risking to be under political pressure to forego the necessary increase in interest rates.

Given the importance for high-debt countries to bring their debt dynamics under control, the following section explores the potential of different options that might be considered in this respect.

3. Exploring different options to bring high government debt levels under control

Even though government debt can make economic and societal sense, certain boundaries should not be overstepped. A public debt level (in proportion to GDP) is considered safe if it is plausible to expect the government to stabilise or reduce it under most circumstances – including persistently adverse ones – using fiscal policy, i.e. excluding default, restructuring or inflation. This notion rests on the requirement for the government to remain solvent with a high degree of confidence, the requirement that returning to safety implies a feasible policy path, and the importance of not losing control of debt dynamics even under adverse conditions (Debrun *et al.*, 2020).

The likelihood of losing control of debt dynamics rises with debt itself. As a result, the upper bound of the safe debt zone must be sufficiently low to accommodate adverse shocks without jeopardising the government's capacity to keep debt dynamics in check. The coronavirus crisis has significantly increased debt-to-GDP ratios in all euro area countries, including in those where debt levels were already high. Moreover, in some high debt countries, such as Belgium, upward debt dynamics are expected to persist also after the crisis.

Exploring different options for restoring fiscal space requires a thorough understanding of debt dynamics (see section 3.1). With the determinants of debt dynamics at hand, it is interesting to explore the impact of policy decisions by the fiscal and the monetary authority on the debt ratio. Using a set of narrative scenarios for Belgium, we first analyse what the fiscal authority, for which ensuring a safe debt level is a key responsibility, can rely on or not to bring debt (dynamics) under control (see section 3.2). Further, we assess whether the monetary authority could help a hand in bringing public debt under control by cancelling (part of) the public debt it holds on its balance sheet (see section 3.3).

3.1 What determines public debt dynamics?

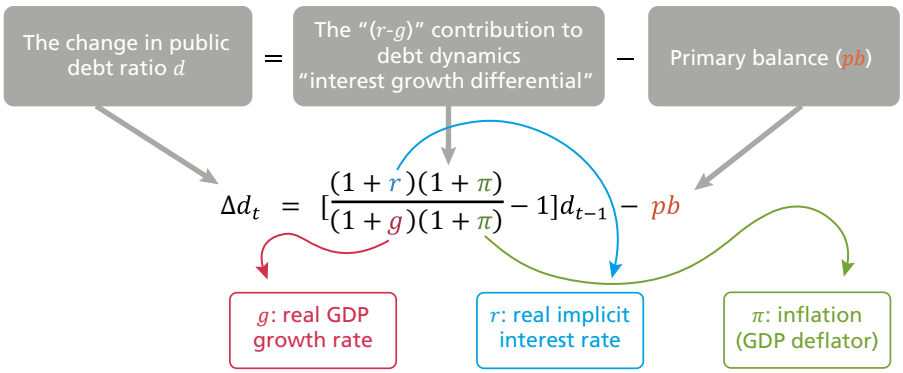
The debt dynamics equation shows the relevant parameters that impact the change in the ratio of debt to GDP in a given year. One can distinguish two broad factors: (i) the primary balance, and (ii) the impact of the interest-rate-growth differential. The primary balance is the difference between government revenues and primary expenditures (i.e. excluding interest payments), both expressed as a share of GDP. The negative sign in the debt dynamics equation indicates that a primary surplus has a downward impact on the debt to GDP ratio.

The impact of the interest-rate-growth differential on debt dynamics, also called the snowball effect and referred to as (r-g), depends on the difference between the implicit interest rate on debt and the nominal growth rate of GDP. Basically, the snowball effect pushes debt up if the nominal implicit interest rate – that is the average interest rate on all government debt – is higher than the nominal GDP growth rate. Intuitively, the ratio of public debt to GDP increases if the numerator (public debt) rises faster than the denominator (nominal GDP). The impact of the interest-rate-growth differential becomes favourable to debt dynamics if the implicit interest rate is lower than the nominal growth rate, as is currently the case. In that case the debt ratio automatically falls, unless it is pushed up by sufficiently high primary deficits.

Chart 2

The debt dynamics equation

(in % of GDP)



Source: NBB.

Note: for the sake of simplicity, this simplified illustration omits stock-flow adjustments.

A full understanding of the determinants of debt dynamics requires a further disentanglement of the nominal implicit interest rate and nominal growth. The nominal implicit interest rate is the average rate on all government debt and is the result of the weighted sum of the market interest rates that applied at the time the debt was issued. When the market interest rate goes up, this only affects interest payments on newly issued or refinanced debt. The resulting new implicit interest rate is only affected gradually, depending on the share of newly issued or financed debt in total government debt. The longer the average maturity of government debt, the longer it takes for a higher market interest rate to translate into a higher implicit interest rate, and hence a higher debt-to-GDP ratio.

Further, the nominal interest and growth rate can be disentangled into a real component and a deflator component. In case of nominal growth, an increase in the GDP deflator immediately gives rise to an increase in the nominal growth rate, which pushes down the debt dynamics. At the same time, an increase in inflation may also give rise to an increase in the nominal market interest rate, if the real interest rate does not fall. Yet, that increase only feeds into the implicit interest rate after a time lag as not all debt is issued or renewed in the same year. Consequently, in the short run, one may expect a downward impact of higher inflation on the debt-to-GDP ratio, as the ratio's denominator rises faster than its numerator.

3.2 Narrative scenarios for public debt dynamics in Belgium

Since the COVID-19 pandemic, Belgium's debt ratio has shot up to 114 % of GDP and – according to the NBB's June 2021 macroeconomic projections – it is expected to be on an upward path from 2023 onwards. Even though it is hard to establish a debt limit beyond which unsustainability lies with near certainty, and an upper bound of a safe zone that offers Belgium a sufficient buffer to accommodate adverse shocks, it is clear that Belgium's debt ratio has come closer to these limits and that at least a stabilisation of the debt ratio in the coming years is desirable.

In order to explore the options for debt stabilisation and reduction, we develop a series of narrative scenarios for Belgian debt over the 2021-2030 horizon. The baseline scenario, which is used as a

benchmark, is based on the Bank's June 2021 macroeconomic outlook, with a projection horizon until 2023. For the 2024-2030 period, the baseline simulation assumes the primary balance achieved in 2023 as a starting point, and factors in population ageing costs and GDP developments[1] as estimated in the Study Committee on Ageing's July 2020 report; the nominal market interest rate on 10-year OLOs is assumed to rise to 0.9 % and inflation and the GDP deflator are set equally at 2 %. The implicit interest rate is falling steadily as the market interest rate remains below the implicit interest rate, which comes to 1.3 % in 2023. Furthermore, from 2024 onwards, the maturity structure of public debt is assumed to remain stable at ten years on average, the interest rates structure is held stable and anchored to the 10-year rate (based on the average differences by maturity in the first four months of 2021), and stock-flow adjustments are put at zero.

In the baseline scenario, the debt ratio rises steadily over the simulation horizon, to 123 % of GDP in 2030. There is an upward impact on debt dynamics from the primary balance, which is expected to record a deficit of 3.1 % of GDP in 2023, and rise further under the influence of ageing costs. This upward impact is tempered by the exceptionally favourable interest-rate-growth differential, which pushes down the debt ratio by three percentage points of GDP on average. All in all, despite the favourable snowball effect, large deficits are expected to push debt steadily upwards.

The narrative scenarios change the values of the variables determining the debt dynamics equation. It should be noted that the scenarios themselves are based on mechanical simulations where one variable of the debt dynamics equation (primary balance, real GDP growth rate, real implicit interest rate or inflation) is changed at a time, without affecting the other variables. Only if the real growth rate is changed, will there also be repercussions for the primary balance via the standard semi-elasticity of 0.62, used by the European Commission to calculate the cyclical component of the budget balance. Even though such a mechanical approach ignores any possible endogenous impacts of one variable on the others, which would result from a more comprehensive model that structurally links these variables[2], it has the advantage of simplicity and transparency in interpreting the results. Moreover, in each of the scenarios, we will argue to what extent the mechanical approach is plausible and how possible endogeneities could alter the results.

How much fiscal consolidation is needed to stabilise the debt ratio?

A first scenario investigates how much the primary balance needs to improve, compared to the baseline, in order to stabilise the debt ratio from 2023 onwards. To achieve this, the primary deficit is set equal to the impact of the interest-rate-growth differential on debt dynamics; the interest-rate-growth differential is unchanged compared to the baseline.

The simulation shows that a consolidation effort of at least 1.5 % of GDP is required just to stop the Belgian debt ratio from rising. It also demonstrates that despite the historically favourable interest-rate-growth differential, at unchanged policy (cf. the baseline scenario), the Belgian government does not succeed in bringing down or even stabilising the debt ratio. The scenario of debt stabilisation can be considered as a minimum condition for keeping debt sustainability under control. To rebuild fiscal space, a significant reduction in the debt ratio is desirable. The advantageous reverse snowball effect should be used to this end.

The mechanical exercise assumes no impact from the fiscal consolidation on the other relevant variables, such as the growth rate. This means that the simulation implicitly assumes a fiscal multiplier of zero. Even though one can argue in favour of a positive fiscal multiplier, which would result in a negative impact of fiscal consolidation on economic activity, a small multiplier can be justified in the case of Belgium, given the open nature of the

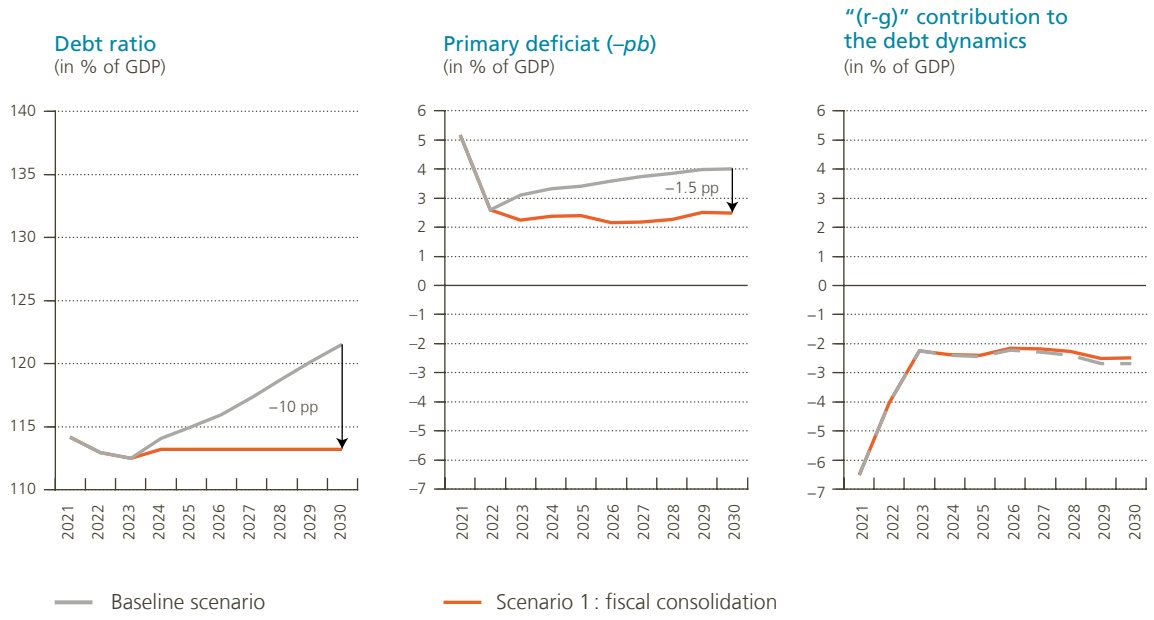
1 The average real growth rate over 2024 and 2030 is set at 1.3 %.

2 There is a rich economic literature reporting similar scenarios based more complex methods, such as in Hilscher *et al.* (2021) and Krause and Moyen (2016) for the US, or Equiza-Goñi (2016) for the euro area.

small Belgian economy, possible confidence gains from a reorganisation of public finances, and provided the composition of fiscal consolidation is not very detrimental to growth. In any case, the required consolidation effort in order to stabilise debt that results from our simulation can be considered as a lower bound compared to a simulation that would assume a positive fiscal multiplier.

Chart 3

How much fiscal consolidation is needed to stabilise the debt ratio?



Source : NBB.

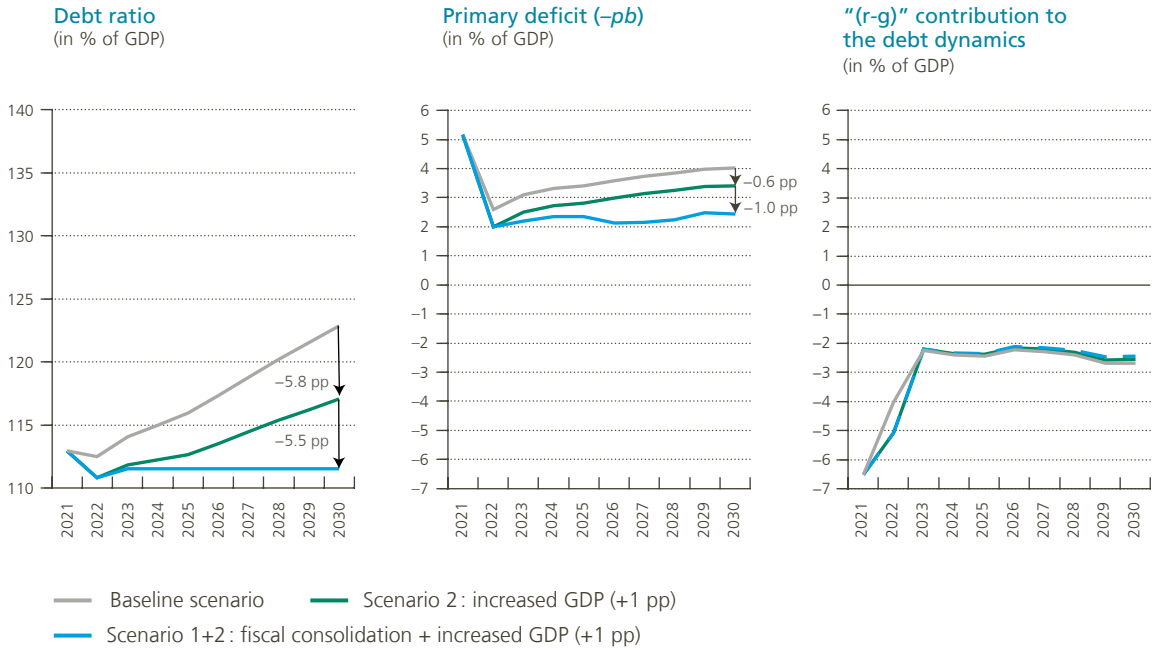
The baseline scenario reflects the NBB's June 2021 macroeconomic projections until 2023. For the 2024-2030 period, the simulation assumes the primary balance achieved in 2023 as a starting point, and factors in ageing costs and assumptions on GDP developments in the July 2020 SCA report. Nominal interest rates are assumed to remain at 0.9 % from 2024 onwards, and inflation (as reflected by the GDP deflator) is set at 2 % from 2024 onwards. Other assumptions include that the maturity structure of the debt will remain stable at ten years on average, that the interest rates structure by maturity (yield curve) is stable compared to the 10-years rate (based on the average differences by maturity in the first four months of 2021) and that no exogenous factors impact the debt ratio.

In a second scenario, we examine to what extent an exogenous increase in Belgian economic activity could help alleviate the budgetary effort necessary to stabilise debt. Therefore, we suppose an increase in GDP with one percentage point in 2022 compared to the baseline scenario. This scenario can be interpreted as one where economic activity broadly returns to a level that was expected without the coronavirus crisis. It is also worth noting that in our mechanical model a permanent increase in economic output level by one percentage point translates into a permanent improvement of the primary balance of 0.62 % of GDP.

The higher GDP level has a downward impact on the debt ratio via a temporary improvement in the interest-rate-growth differential, and via the permanent downward shift of the primary deficit. Under these macroeconomic conditions, the consolidation effort required to stabilise debt – at a lower level – is much smaller than in the previous scenario. As a result, structural policies that boost economic activity, either by raising labour market participation or propping up productivity, also play an important role for debt sustainability. It should be noted that as long as the enhanced economic activity is limited to Belgium, it is justifiable that nominal interest rates do not go up, since Belgium is too small to affect the euro area monetary policy stance.

Chart 4

To what extent does higher economic activity help to alleviate the budgetary effort?



Source : NBB.

What if financial markets question sovereign debt sustainability?

The third scenario tests the implications for public debt if financial markets lose confidence in Belgian public finances. To analyse this question we assume an exogenous increase in the risk premium of three percentage points from 2022 onwards compared to the baseline[1], taking the nominal market interest rate towards 3.9 %. All other variables are kept constant in this stress test scenario.

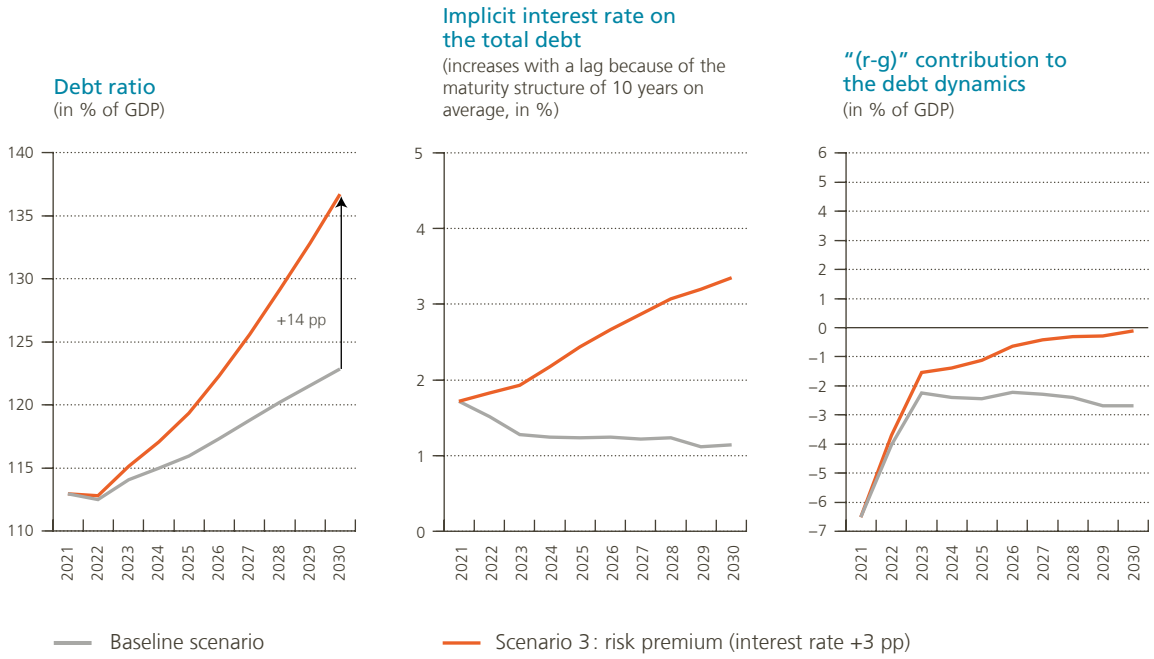
In these circumstances, the implicit interest rate steadily increases towards more than 3 % in 2030. As a result, the favourable interest-rate-growth differential fades, and the reverse snowball effect gradually grinds to a halt. Note that the increase in the implicit interest rate is very gradual, compared to the sudden rise in the market interest rate. This is because of the relatively long average maturity of public debt in Belgium, which currently stands at around ten years. This implies that, on average, only one-tenth of public debt is re-financed every year at the new market conditions. This scenario results in an increase in the debt ratio to 137 % of GDP by 2030 with no change in fiscal policy.

This scenario demonstrates the importance of keeping the trust of financial markets, and illustrates the possible adverse consequences of not shoring up public finances with structural measures. It also shows that thanks to the lengthening of the debt maturity in Belgium, from six years on average in 2009 to ten years now, the financing implications of a sudden increase in risk premia would be buffered, giving the government additional time to take necessary action. At the same time, this scenario also indicates what would happen if the historically favourable financing conditions disappear.

1 Three percentage points corresponds to the spread of Belgian ten-year linear bonds vis-à-vis the German Bund end November 2011, in the midst of the sovereign debt crisis.

Chart 5

What if the risk premium on sovereign debt goes up by three percentage points?



Source: NBB.

Here, too, it should be recognised that the mechanical exercise has its limitations. One could expect that such a sharp rise in the risk premium would have negative implications for the real economy because of the loss of confidence among economic agents and tightening credit conditions. This would further aggravate the situation. In that respect the upward impact on debt from an increase in the risk premium in our mechanical simulation can be seen as a lower bound.

Can higher inflation bring public debt back onto a sustainable path?

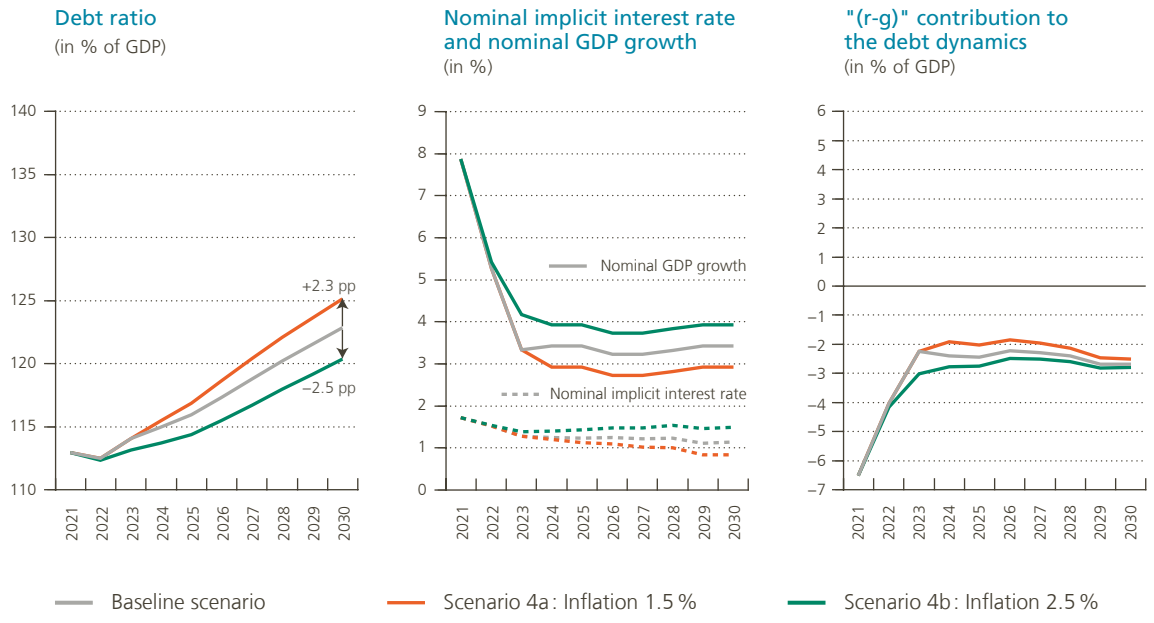
A fourth set of scenarios analyses the impact of inflation on debt sustainability. As higher inflation reduces the real value of government debt, it is often seen as one of the factors that can contribute to the alleviation of debt sustainability concerns. In order to investigate inflation's role, we compare a low and a high inflation scenario. For the sake of simplicity, we assume that inflation equals the GDP deflator from 2024 onwards, which implies that the inflation shock in Belgium does not originate from a change in the terms of trade. The low inflation scenario is one where inflation muddles on at 1.5 % from 2024 onwards, which corresponds to the average of the GDP deflator of the past decade, and remains below the ECB's target of 2 %. The high-inflation scenario assumes a rise in inflation to 2.5 % from 2024 onwards, which would allow to steadily make up for the low inflation in the last years.

A crucial issue in these scenarios is what happens to the nominal – and consequently real – interest rate. We assume in both scenarios that the real market interest rate is kept constant compared to the baseline scenario, meaning that the change in inflation is fully passed into a change in the nominal market interest rate. Concretely, in the low-inflation scenario the market interest rate falls to 0.4 %, while it jumps to 1.4 % in the high inflation scenario. Further, we assume that the inflation shock is exogenous, i.e. not originating from a change in GDP growth or the output gap vis-à-vis the baseline scenario, and euro-area-wide, which warrants a monetary policy reaction by the ECB (so that interest rates change).

The simulation results show that the high inflation scenario would result in a fall of 4.8 percentage points of GDP in the debt ratio compared to the low inflation scenario. The favourable debt dynamics in the high-inflation scenario originate from the faster upward impact of higher inflation on the nominal growth rate than on the nominal implicit interest rate, yielding a temporary improvement in the interest-rate-growth differential. The higher GDP deflator/inflation immediately impacts the nominal growth rate and the nominal market interest rate. The implicit nominal interest rate, in his turn, is only gradually affected, as public debt is refinanced little by little over the simulation horizon.

Chart 6

What is the impact of inflation on the debt ratio?



Source: NBB.

The simulation shows that the impact of higher inflation on the debt ratio crucially depends on the impact on the implicit interest rate (on all government debt), which is driven by two factors. First, the debt reducing impact from higher inflation is greater, the less the nominal market interest rate rises with inflation. In our simulation, market interest rates react one-to-one to inflation. Were monetary policy to be more accommodative, market interest rates would rise by less than the increase in inflation, and the debt-reducing impact would be higher. The opposite would hold if monetary policy were more restrictive. Second, the debt-reducing impact of higher inflation is greater, the longer the average maturity of public debt. With an average maturity of ten years in Belgium, it takes on average ten years for the higher market interest rate to fully translate into the implicit interest rate.

The simulations above abstract from the fact that the Eurosystem owns more than 15 % of Belgian government debt[1]. As explained in the next section, the fact that the Eurosystem's purchases imply a de facto swap from longer- to short-term interest rates, dampens the impact from maturity lengthening by the treasury, and makes the effect of surprise inflation less beneficial for public finances. Government debt residing on the balance sheet of the central bank also provokes another question: does debt cancellation by the central bank provide an easy way for creating fiscal space? This issue will be discussed in the next section.

1 The NBB owned 16 % of Belgian government debt end 2020. Also the ECB holds a small share of Belgian government debt as it manages approximately 10 % of the Eurosystems' purchases of national government debt.

3.3 Can debt cancellation by the central bank create fiscal space faster?

The simulations above illustrated that current monetary policy – in pursuing its price stability mandate – contributes positively to government debt dynamics. More specifically, the current low interest rate policy creates favourable conditions for stabilising debt dynamics while an inflation rate closer to the price stability objective would further benefit fiscal positions. However, both will not quickly nor drastically reduce high government debt levels. Another proposal that has recently gained momentum does see a way for monetary policy to achieve this. It entails cancelling the government bonds that ended upon the central bank balance sheets via asset purchase programmes. In February 2020, for instance, more than 100 voices (mostly from economists)[1] called upon the Eurosystem to write down the government bonds it has purchased. The freed-up fiscal space could then be used by governments to finance green investment and social programmes.

The following paragraphs assess the merit of this proposal[2]. In contrast to the practical simulations above (that used recent data and projections for Belgium), the analysis here is conceptual. It uses simplified balance sheets to bring stylised insights, making abstraction of the complex institutional setting in the euro area as well as of specific accounting rules (the focus here is on the economic reasoning). In addition, the central bank explicitly enters the picture, forming, together with the government, the official sector.

After asset purchase programmes, official funding is more short term …

In order to assess the proposal of debt cancellation by the central bank, it is useful to take a step back, to when the central bank acquired the debt. The simplified balance sheets in chart 7 illustrate four different scenarios.

Under its asset purchase programmes (panel B), the central bank buys government bonds from the private sector (in the stylized example it concerns one third of the bonds outstanding) and finances these purchases by issuing central bank reserves (see box 1 for a brief explanation). The private sector now holds longer-term government bonds and short-term central bank reserves and earns interest on both[3]. The central bank also receives interest on the government bonds it holds but it transfers its profits (the difference between interest earned on assets and interest paid on liabilities in our simple example) back to the government.[4]

… which has lowered the official sector's debt servicing costs

Overall, from a financial flow perspective, central bank asset purchases yield two gains for the official sector (compare A with B). First, by replacing higher-yielding government bonds with lower-yielding central bank reserves, the official sector pays lower interest costs to the private sector. Note that the steeper the yield curve, the more significant the interest cost savings will be. Second, as central bank asset purchases lower longer-term government bond yields, the government has to pay a lower interest rate on newly issued bonds.

It should be noted, though, that asset purchase programmes are a temporary policy. At some point in the future, depending upon the economic recovery and, in particular, the inflation outlook, large-scale central bank asset purchases will end, followed by a phasing out of the reinvestment of matured bonds. Panel C depicts the end result of what in practice will be a very slow process: the unwinding of asset purchases. In the example, the

1 See the open letter "Cancel the public debt held by the ECB and 'take back control' of our destiny" published on 5 February 2021 in several newspapers.

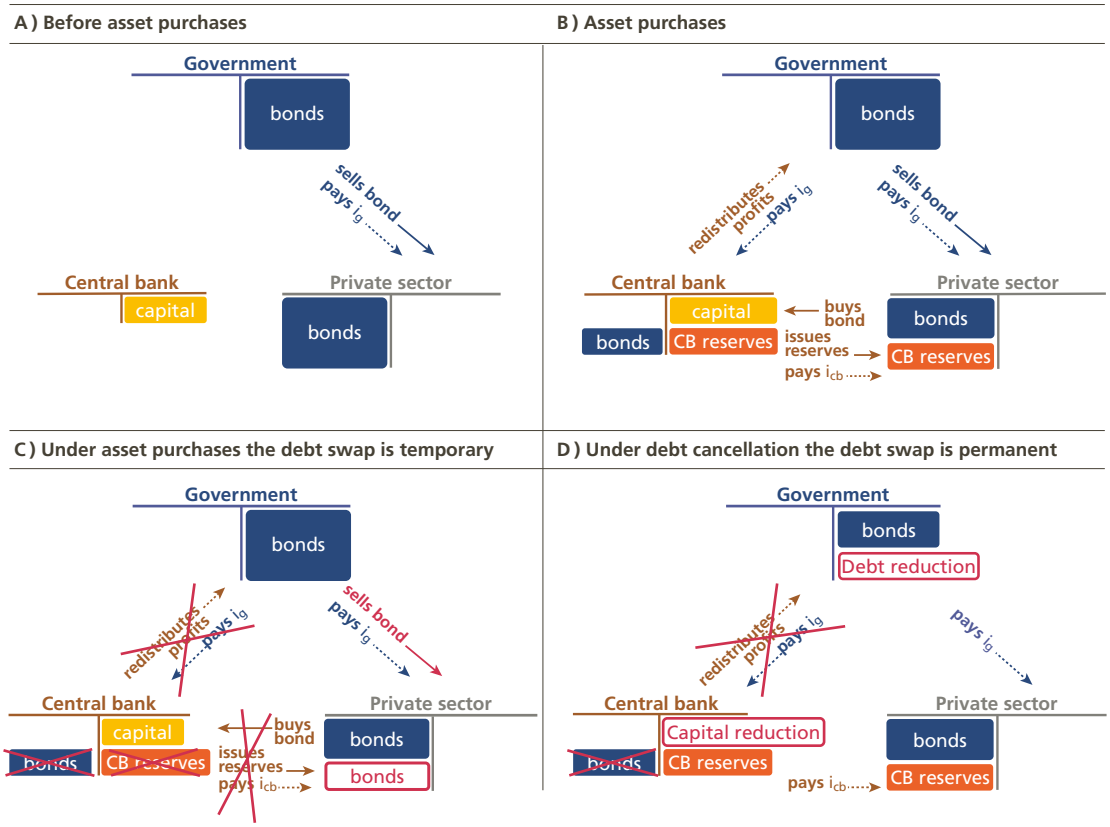
2 It builds on the reasoning in Boeckx and Debrun (2021). For ECB Executive Board members' view on the matter see for instance an interview of Philip Lane with Süddeutsche Zeitung on 31 January 2021, Christine Lagarde with Le Journal de Dimanche on 7 February 2021 and of Luis de Guindos with Público on 2 March 2021 available on Interviews (europa.eu).

3 In practice, the Eurosystem buys government bonds from the banking sector – which sells the bonds it has on its balance sheet or acts as an intermediary selling the bonds of its clients – and issues central bank reserves in return, which can only be held by the banking sector.

4 Two refinements should be added here, though. First, the central bank might reserve part of its profits before distributing them to the government. That is because the central bank risks incurring losses on these bonds, which could threaten its financial independence. The recycling of interest payments is thus not perfect from the point of view of the government, but it is when considering the official sector as a whole. Note that the lower central bank dividends are offset by a larger central bank capital base which benefits the shareholders, most often the government. However, and secondly, some central banks, including the NBB, also have private shareholders, which entails that the recycling of interest payments will not be perfect.

Chart 7

Central bank asset purchases versus debt cancellation: an illustration using simplified balance sheets



Source: NBB.

government repays the maturing bonds on the central bank balance sheet through refinancing, with the new bonds being bought by the private sector[1]. Consequently, the government bonds on the central bank's assets side disappear as do the central bank reserves on the liabilities side, because the government extracts resources from the private sector to finance its debt rollover. As a result, each agent's balance sheet has returned to the situation prior to the central bank buying assets (panel A = panel C). The private sector again only holds government bonds and no central bank reserves.

After debt cancellation, official sector debt would not fall …

Under debt cancellation (panel D), the repayment to the central bank never happens and the swap of long-term government debt for short-term central bank debt will be permanent. When the central bank cancels the government bonds on its balance sheet, government debt does actually fall, but the central bank reserves that were issued to finance the purchase of government bonds do not. As a result, from a stock perspective, debt cancellation does not reduce interest-bearing official sector debt. More precisely, the official sector's debt stock in private hands remains the same in all four scenarios even if its maturity structure and issuer status does not.

1 The example assumes an unchanged stock of government bonds, requiring a debt rollover.

In addition, it should be noted that debt cancellation implies the central bank registering a loss on the assets side of its balance sheet which eats into the capital on its liabilities side. In theory, a central bank can operate with low or negative capital as its money-creation power enables it to generate revenue in the future with which it can gradually cover any losses incurred[1]. In practice however, this will likely mean that, in order to restore its capital position, the central bank lowers or simply stops the profit flows it distributes to the government. So, the government no longer pays interest on the cancelled government bonds, but it also no longer receives dividends from the central bank. Moreover, in an extreme situation, it could be that the revenue a central bank can raise in the future under a price-stability-oriented monetary policy is insufficient to cover the capital loss. Either, the government then steps in and recapitalises the central bank. Note that while this would allow monetary policy to remain committed to controlling inflation, the fiscal authority would see its increased fiscal space from debt cancellation evaporate. Or, in the absence of fiscal backing, the central bank may have to exploit its revenue-generating capacity which will inevitably result in higher inflation and thereby in the central bank forsaking its price stability mandate. Of course, the mere perception of a weak central bank balance sheet could erode the public's trust in the central bank and in the money it issues and thus result in higher inflation.

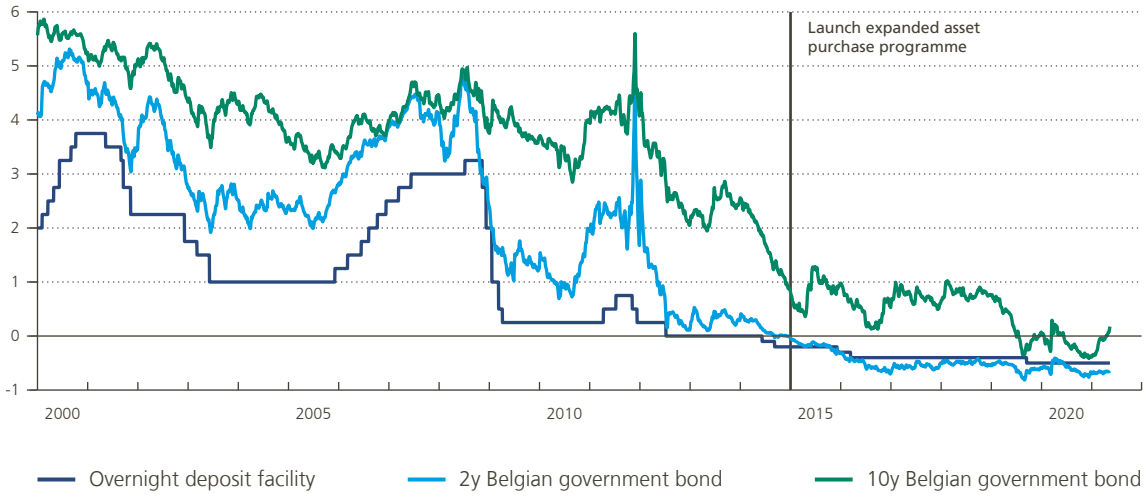
… nor would debt servicing costs drop further

Thus, also, from a financial flow perspective, debt cancellation does not seem to bring any additional benefits compared to central bank asset purchases. Halting the circular interest payments within the official sector (under debt cancellation) or not (under asset purchases) makes little difference: in both cases, the central bank keeps paying the interest on central bank reserves to the private sector. And, as noted above, under debt cancellation, the government is likely to receive lower profits from a central bank that is restoring its capital position. In addition, permanently financing a part of the official debt at the interest rate on central bank reserves instead of at the interest rate on government bonds, yields little benefit when the yield curve is flat (as is currently the case) with $i_{cb} \approx i_g$ (see chart 8). The larger share of short-term funding in the official funding mix also makes official debt more sensitive to central bank interest rate rises.

1 For a deeper analysis on central bank insolvency, see Reis (2015).

Chart 8

Short-term instead of long-term funding yields little benefits when the yield curve is rather flat



Source: Refinitiv.

If the central bank were to raise its policy rates in the future, interest rates on both central bank reserves and governments bonds would go up. Given their overnight maturity, the former will rise immediately whereas the latter will go up more slowly as the longer maturity of the bonds insulates the government from paying higher interest rates for some time. In this respect, the lengthening of the average maturity of euro area government debt since the launch of the Eurosystem's asset purchase programme in 2015 – through locking in low interest rates – will prove beneficial. It should be noted that both asset purchases and debt cancellation imply a faster pass-through of a monetary policy tightening into official borrowing costs, but the shortened maturity structure of official debt is only permanent under the latter scenario.

Overall, debt cancellation following central bank asset purchases makes no economic sense. Asset purchases lower the official sector's debt servicing costs (especially when the yield curve is steep). Debt cancellation does not bring additional financial gains, as it leaves unchanged the stock and maturity structure of interest-bearing official debt in private hands, and hence interest payments to the private sector. Moreover, there are other counter-arguments.

BOX 1

Explainer: What are central bank reserves?

The central bank has the monopoly over the issue of money with legal tender. This money can take two forms: 1) physical money, being banknotes in circulation, that can be used by all economic agents to settle transactions and which yields no interest or 2) electronic money, being central bank reserves, that can only be used by the banking sector to settle transactions among commercial banks or with the central bank and on which the central bank pays interest. Both forms of money represent the most liquid, risk-free assets in the economy; they are claims that society has on the central bank.

Central bank reserves can further be divided into two categories, namely required reserves and excess reserves. In the Eurosystem, commercial banks have to hold 1 % of their short-term liabilities, mostly retail customers' deposits, at their national central bank. These required reserves are remunerated at the rate on the main refinancing operations (MROs) which currently stands at 0 %. Reserves that banks hold in excess of the required reserves are remunerated at a lower rate, namely the deposit facility rate which currently stands at –0.5 %. As of the end of 2019, a part of these excess reserves is also remunerated at the MRO rate in order to avoid strains in the transmission of monetary policy to firms' and households' borrowing conditions[1].

How are central bank reserves created? In normal times, the central bank plays a rather passive role in the creation of reserves as it issues reserves in tune with banks' liquidity demand. The Eurosystem used to estimate the liquidity needs of the banking sector and provided that amount in the form of loans to banks. On the assets side of the Eurosystem's balance sheet, this would result in an increase in its monetary policy operations (like the main refinancing operations), while on the liabilities side, the central bank reserves would go up. After the great financial crisis, however, the Eurosystem has taken a more active role in the creation of central bank reserves. For instance, its asset purchase programmes – employed to support inflation when policy rates are near their lower bound – are financed by the issuance of central bank reserves. Consequently, whereas prior to the financial crisis the amount of central bank reserves was relatively small and predominantly consisted of required reserves, since then, the amount has increased significantly (by a factor of fourteen in the Eurosystem) and is mainly made up of excess reserves.

1 For more details on the two-tier system, see for example box 2 in the NBB Annual Report (2019).

Other counter-arguments

First, there is a legal obstacle, as Article 123 of the Treaty on the Functioning of the European Union prohibits monetary financing. Second, the current environment does not force high-debt countries to undertake any swift and significant debt reduction (which is often economically harmful). Financial markets are currently not questioning the fiscal sustainability of government debt paths and the favourable interest-rate-growth differentials support the sustainability of high debt levels (see also previous sections). Hence, there is no need to look for an alternative, supposedly less painful way to deal with high debt. Third, debt cancellation risks damaging the credibility of the official sector. On the one hand, it may result in the "risk-free" status of government bonds being called into question, leading to higher risk premiums and thus higher interest rates. On the other hand, debt cancellation by the central bank may result in the latter's commitment to price stability being doubted or in a loss of trust in the currency, leading to higher inflation and higher interest rates.

Taking into account the lack of economic benefits and the many risks, the debt cancellation proposal does not appear to be a promising option to pursue.

Conclusion

At the lower bound, when macro-economic policy space is limited, a close interaction between monetary and fiscal support measures is necessary to successfully address negative shocks. Once the crisis mode is behind us, it is important to restore stretched policy space implying that the fiscal authority focuses on debt sustainability, allowing monetary policy to continue focusing on its mandate of price stability. By credibly committing to their respective objectives, monetary and fiscal policies will be best equipped to tackle future challenges that may emerge in bad times (consider, for instance, extreme shocks hitting the economy in a lower bound environment) as well as in good times (consider, for instance, normalizing policy rates in a high debt environment).

The article has focused on restoring fiscal space in countries with high and rising government debt levels. For now, governments' solvency is generally not being called into question but as the debt sustainability assessment and perception could quickly turn, it is important to commit to credible debt strategies. In Belgium's case, the analysis has shown that the current favourable impact of interest rates remaining well below trend economic growth are not enough to stabilise government debt over the next decade, let alone bring it back onto a downward path. And interest rates' future course is uncertain. Inflation's potential for devaluing debt is also limited, especially when considering inflation ranges that are consistent with the price stability mandate. Considerable consolidation efforts will thus be needed to achieve a turnaround in the Belgian debt trajectory. On top of that, lifting and sustaining higher economic growth – through growth-friendly fiscal policies and structural reforms – appears paramount.

A clear commitment by governments to debt sustainability avoids the central bank being pressured to take debt concerns into account when setting monetary policy. Trough steering interest rates and inflation, the central bank does have an impact on debt dynamics. Unconventional policies, like central bank government bond purchases, have further enhanced the links between monetary and fiscal policy. But as already set out in the pre-crisis framework, monetary policy is not responsible for guaranteeing debt sustainability. History has shown that such an assignment risks leading to adverse economic outcomes. The article also shows that the seemingly simple solution of cancelling the government bonds on the central bank balance sheets will not deliver the result hoped for : it is not a free lunch, but potentially risky and generally unnecessary.

Overall, the low interest rate and high debt environment will remain challenging for monetary and fiscal policies to navigate but it should be manageable. When governments credibly stand by the core objectives of fiscal policy – i.e. contributing to durable and equitable economic growth via an optimal allocation of available resources, while keeping debt dynamics in check –, macro-economic policy space may gradually be restored without having to resort to drastic measures.

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Indebtedness around the world: Is the sky the limit?

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F. De Sloover
D. Essers*

Introduction

Even before the COVID-19 crisis, global debt was near record levels and steadily increasing. The sharp fall in economic activity triggered by the pandemic and the actions taken in response to it have caused a further, massive jump in global debt burdens. According to estimates by the Institute of International Finance, the combined debts of governments, non-financial corporations, the financial sector and households around the world stood at a dazzling $ 289 trillion at the end of the first quarter of 2021, or about 360 % of world GDP, some $ 30 trillion up from end-2019 (IIF, 2021).

This article describes the sky-high global debt mountain from a bird's eye view. We adopt a broad lens. Both public and non-financial corporate debt are discussed – as they account for the largest increases in nominal debt levels since the global financial crisis (GFC) – in advanced economies as well as major emerging economies. We concentrate on the debtors' perspective, i.e. the point of view of the indebted governments and companies, rather than on the creditors'/investors' side. Our discussion focuses on the post-GFC evolution of global debt, often framed within a longer-term, historical context. Special attention will be devoted to the impact of the COVID-19 crisis.

The article is structured as follows. Section 1 presents the main stylised facts and describes the current trends in public and corporate debt, with a separate box dedicated to the special case of China. As well as illustrating the record levels of global debt, we examine their underlying drivers, including the steady decline in interest rates and consequent strong search for yield. Section 2 then discusses the disadvantages and risks associated with high debt, based on a review of the relevant literature. We look at the relationship between public debt and economic growth, and debt sustainability concerns. We thereby pick up on the ongoing debate about the implications of a negative interest rate-growth differential (the so-called "r-g") for public debt dynamics and consider country differences in investor bases and debt tolerance. This section also addresses the risks associated with high corporate debt, including the link between high leverage and low private investment, and the misallocation of resources and low productivity growth. Section 3 considers the way forward, i.e. it details some of the different policy options that exist to reduce debt burdens or, at least, to keep them under control. For governments, these include so-called "heterodox" strategies such as public debt restructuring, generating surprise inflation or

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financial repression; none of which appear to offer a viable way out for advanced or major emerging economies. We argue that what is needed instead is a combination of more "orthodox" policies, where the optimal mix of crisis support, investment to boost potential growth, and fiscal consolidation depends on countries' fiscal space and the pace of their recovery from the COVID-19 crisis, as well as credible medium-term plans. For the containment of corporate debt problems, helpful policy tools comprise the use of flexible, state-contingent support measures in the acute phase of the crisis, reforms to corporate debt restructuring and insolvency procedures, and the promotion of equity financing. The final section wraps up our main findings and key policy recommendations.

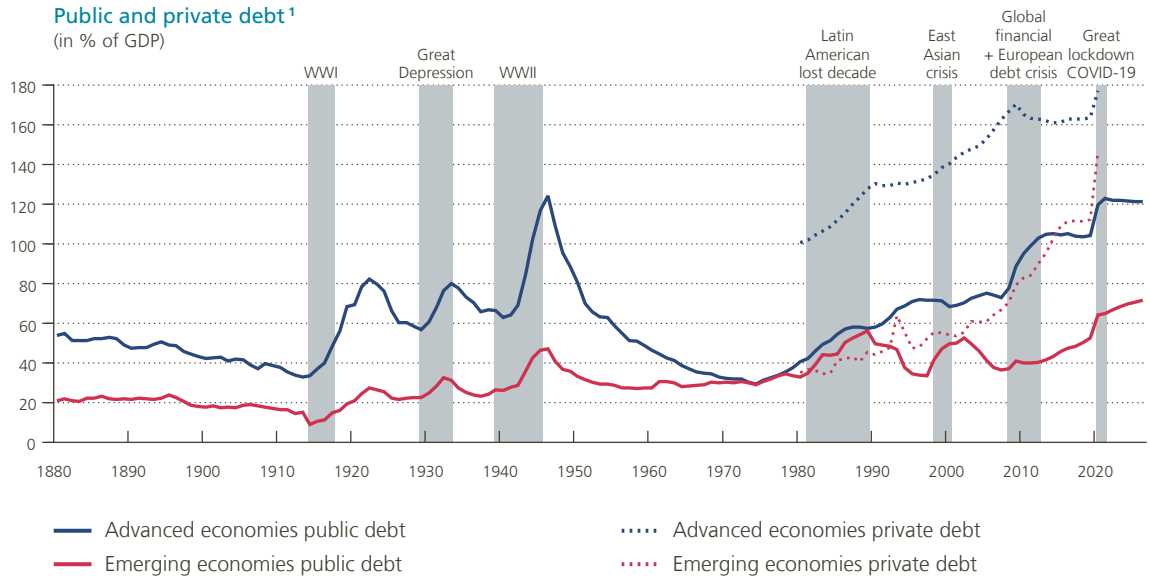
1. Stylised facts and trends

1.1 Record levels of global debt

A first important fact is that the ratios of public debt (of general governments) and private debt (of the non-financial corporate sector and households) to GDP are reaching historic highs, as illustrated in chart 1. This is the case in both advanced economies and emerging economies, even though on average debt ratios are higher in the first than in the latter country group, due to higher degrees of financial development and integration.

Chart 1

Public and private debt are reaching historic highs



Sources: IMF, BIS, Mbaye *et al.* (2018).

1 Advanced and emerging economy aggregates are based on samples of 25 and 27 countries, respectively, weighted by GDP in purchasing power parity terms. Public debt ratios beyond 2020 are IMF forecasts as of April 2021.

We notice that the current (weighted average) public debt ratio of advanced economies is very similar to that observed at the end of World War II. At that time, the strong and sturdy post-war decline in the public debt ratio

was the consequence of an exceptional combination of very fast economic growth fuelled by the reconstruction, persistently high inflation, and extensive financial repression[1] including international capital controls – which lasted well into the 1970s (Reinhart and Sbrancia, 2015; Eichengreen *et al.*, 2020). Other major jumps in the public debt ratio of advanced economies coincide with World War I, the Great Depression of the 1930s, the GFC and the ensuing European sovereign debt crisis, and finally the COVID-19 crisis and its "Great Lockdown" (IMF, 2020). Unlike World War II, these shocks and crises were followed (or are expected to be followed in the medium term, for the latter crisis) by much more modest (if any) debt reductions, and overall public debt has been on an upward trajectory since the mid-1970s.

The public debt ratio of emerging economies tends to follow a less steep path but is equally characterised by waves of debt accumulation (Kose, Nagle *et al.*, 2020). Here too, the largest debt jumps are associated with well-known crises, most notably the Latin American sovereign debt crisis of the 1980s (the so-called "lost decade"), the East Asian crisis (which followed a period of rapid corporate debt build-up), and again COVID-19.

Chart 1 also shows the enormous surge in private debt since the 1980s, interrupted only by short periods of deleveraging in recent, pre-COVID years. Moreover, the private indebtedness of emerging economies is catching up rapidly with that of advanced economies. Section 1.3 will delve deeper into these trends. Before that, we take a look at past and expected trends in public debt and its drivers.

1.2 Evolution and drivers of public debt

What explains the fast increase in public debt since the GFC, most apparent in advanced economies but also present in emerging economies? For selected countries, chart 2 shows the annual percentage point changes in the public debt ratio since 2006 and breaks down those changes into the respective contributions from the primary fiscal deficit, the difference between the real implicit interest rate on debt and real GDP growth (the famous "r-g" or snowball effect), and other factors (the "residual")[2]. Since advanced economies were at the epicentre of the GFC, not emerging economies, support packages and efforts to safeguard the stability of the financial system had a big impact on public debt in the former countries in 2008-2009. Thereafter, public debt levels remained, on aggregate, rather stable. The exact dynamics vary between countries but, on the whole, we see that no or hardly any fiscal buffers were rebuilt, in the form of debt reductions, before the COVID-19 crisis hit. There was often a beneficial impact of negative interest-growth differentials, leading to an automatic tempering of the debt ratio, but the inverse snowball effect was not always large enough to compensate for primary fiscal deficits. This is most apparent in the cases of France and the United States[3]. Even though China and Turkey experienced much faster GDP growth than advanced economies and felt a relatively small impact of interest payments (given their comparatively low initial public debt ratios), they too saw their debt ratios rise on account of growing primary deficits in recent years, as well as residual factors. The large positive residuals for China are largely explained by local government financing vehicles (see box 1 on China) which are not well captured in the country's primary deficit due to classification issues, especially not in earlier years. In Turkey, the residuals mostly represent the debt-augmenting effects of (severe) exchange rate depreciation, since a significant part of Turkish debt is denominated in US dollar and euro.

1 We will return to the concept of financial repression in section 3.1.1, where we discuss heterodox approaches to debt reduction.

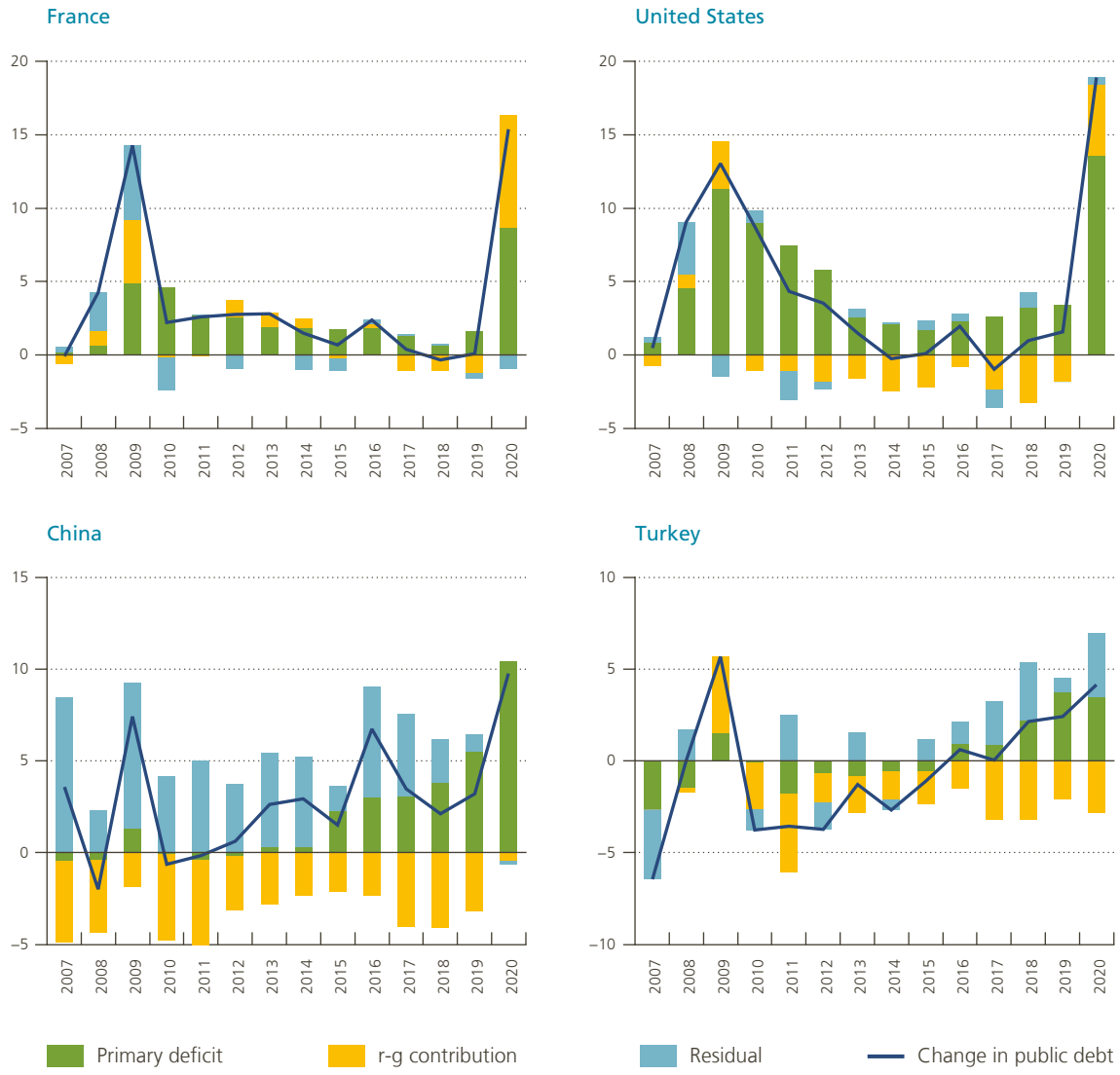
2 This decomposition is based on the standard debt dynamics accounting identity, which can be written as $\Delta d_t = \frac{r_t - g_t}{1+g_t} d_{t-1} - pb_t + sfa_t$. *d* stands for the debt-stock-to-GDP ratio, *pb* for the primary fiscal balance (also relative to GDP) and *sfa* for the stock-flow adjustment, a residual factor capturing the difference between the debt-creating/reducing flows and the change in the debt stock. *r* is the implicit interest rate on public debt expressed in real terms, i.e. the ratio of the interest bill to the debt stock that was outstanding in the previous period, and *g* is real GDP growth.

3 These conclusions broadly hold for most other major advanced economies, with some notable exceptions (like Germany).

Chart 2

Post-GFC evolution of public debt: few signs that buffers were replenished

Decomposition of changes in public debt[1]
(in percentage points of GDP)



Source: IMF.

1 Decomposition is based on standard debt dynamics accounting identity (see footnote 2 in section 1.2 of main text).

Even if the relationship between interest rates and public debt is complex and may be influenced by third factors[1], the (very) low interest rate environment has undoubtedly facilitated the accumulation of debt by governments. As the left-hand panel of chart 3 shows, historically (especially in the post-war era) there is a negative correlation between the level of nominal long-term market interest rates (sovereign bond yields) and public debt ratios in advanced economies. The current record-low public borrowing costs in advanced

1 For example, Mian *et al.* (2021) present a framework showing how rising income inequality and financial sector deregulation can push economies into a low rate-high debt environment.

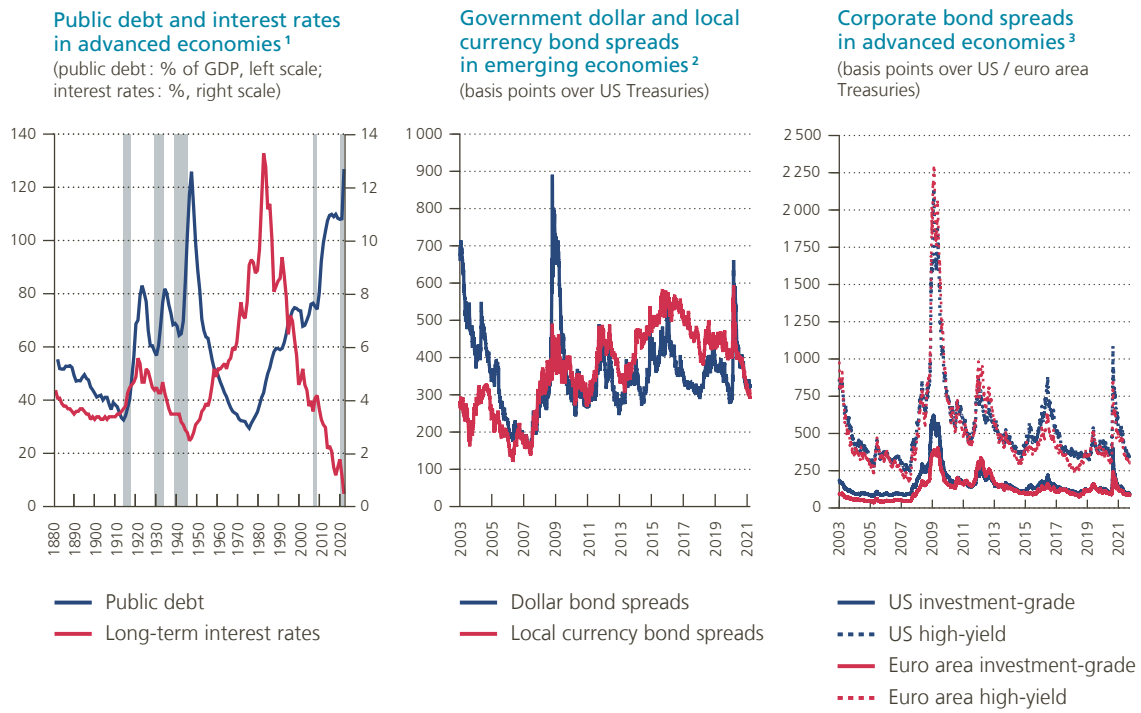
economies are partly the result of sustained low policy rates and asset purchase programmes of central banks, whose policies are in turn (as per their mandates) a reaction to the persistently low natural or equilibrium interest rate also known as "r-star" (i.e., the interest rate consistent with an economy operating at full output potential and stable inflation; see Holston *et al.*, 2017). While the exact factors underlying the global decline in r-star to its current low levels are still being debated, most experts point to structural forces boosting savings and/or curbing investment. The most-cited forces include population ageing in Western countries and East Asia (which increases saving for retirement); flagging productivity growth (which discourages investment); increased risk aversion and demand for safe assets (which leads to more precautionary saving), reinforced by the GFC; and a worsening of income inequality in many countries (given that wealthier people have a higher propensity to save) (see, for example, Bean *et al.*, 2015; De Backer and Wauters, 2017; Brand *et al.*, 2018)[1]. Thanks to low market interest rates, the average advanced economy government saw its interest bill as a percentage of GDP decline from 2.6 % in 2007 to 2.0 % in 2020, while its public debt ratio rose from 71 % to 120 % over the same period (IMF, 2021a).

Most major emerging economy governments have also taken advantage of the low interest rate environment to issue more debt. Even though spreads (over advanced economy government paper like US Treasuries) on dollar

1 See Borio *et al.* (2017) for a contrarian view, assigning more weight to the role of monetary policy in driving real interest rates over longer horizons.

Chart 3

Low market interest rates and spreads have facilitated global debt accumulation



Sources : IMF, JPMorgan, Bank of America-Merrill Lynch, Refinitiv.

1 Advanced economy aggregate is based on sample of 20 countries, weighted by GDP in purchasing power parity terms.

2 Dollar bond spreads are JPMorgan EMBI Global stripped spreads, and local currency bond spreads are spreads based on JPMorgan GBI-EM Traded Index.

3 Corporate bond spreads are option-adjusted spreads based on ICE BofA fixed income indices.

and local currency bonds of emerging country governments can be quite volatile, the middle panel of chart 3 indicates that, on average, there have been no major surges in spreads since the GFC, with the exception of the short-lived spike during the first few months of the COVID-19 pandemic. This implies that average government borrowing costs in emerging economies, which are the sum of (downward trending) advanced economy government interest rates and spreads (moving sideways), have declined too. The average emerging economy government faced about the same interest expenses in 2020 (2.1 % of GDP) as it did in 2007 (2.3 %), despite the significantly larger debt ratio (64 % compared to 36 %) (IMF, 2021a). Of course, there are large differences between individual emerging economies in this respect.

As far as the impact of the COVID-19 crisis is concerned, IMF (2021a) figures reveal that the 16 and 10 percentage point jumps in public debt ratios between 2019 and 2020 in advanced and emerging economies, respectively, are the result of both massive fiscal support (especially in advanced economies) and severe output drops. As of mid-March 2021, advanced and emerging economies had announced COVID-19 support measures – for implementation in 2020, 2021 and beyond – representing an estimated $ 10 trillion in additional spending and foregone revenues (IMF, 2021b). This support amounted to about 16 % (4 %) of 2020 GDP in advanced (emerging) economies.

As chart 1 shows, public debt ratios are not expected to revert back to their pre-COVID levels any time soon, according to the latest medium-term projections[1]. For advanced economies, it is projected that the overall public debt ratio will stabilise close to the current record levels, as growth recovers and fiscal support measures are gradually unwound. This masks some heterogeneity, however : the public debt stock of the United States will likely rise even further due to newly announced fiscal packages by the Biden Administration[2], whereas that of the euro area is deemed to slowly diminish over the coming years (IMF, 2021a), in part because of the phasing out of crisis support measures. The public debt ratio of the emerging economies group is estimated to remain on an upward trajectory over the medium term, mostly on account of relatively moderate fiscal adjustments in the average country, a trend that is strongly driven by China. In addition, the fiscal outlook is subject to the risk that certain "contingent liabilities" from liquidity support measures, such as the huge state guarantees provided by several advanced and major emerging economy governments on bank loans, eventually materialise and end up on governments' balance sheets[3]. Moreover, in the longer run, most advanced and several emerging economies can expect additional fiscal pressures from population ageing (European Commission, 2021 ; Guillemette and Turner, 2021).

1.3 Evolution and drivers of corporate debt

As mentioned above, not only public but also private debt ratios, again expressed in percentages of GDP, have recently peaked at record levels. Looking at the two categories of private non-financial debt, namely household and non-financial corporate debt, it appears that the latter recently surpassed GDP levels both in advanced and emerging economies (see chart 4, left-hand panel). Besides public debt, non-financial corporate debt was also the largest contributor to the strong increase in global debt in recent years.

Although household debt too grew continuously in emerging economies since the GFC, its outstanding stock remains much smaller than non-financial corporate debt. In advanced economies, a significant deleveraging process took place on households' balance sheets in the aftermath of the GFC. This is not surprising, as

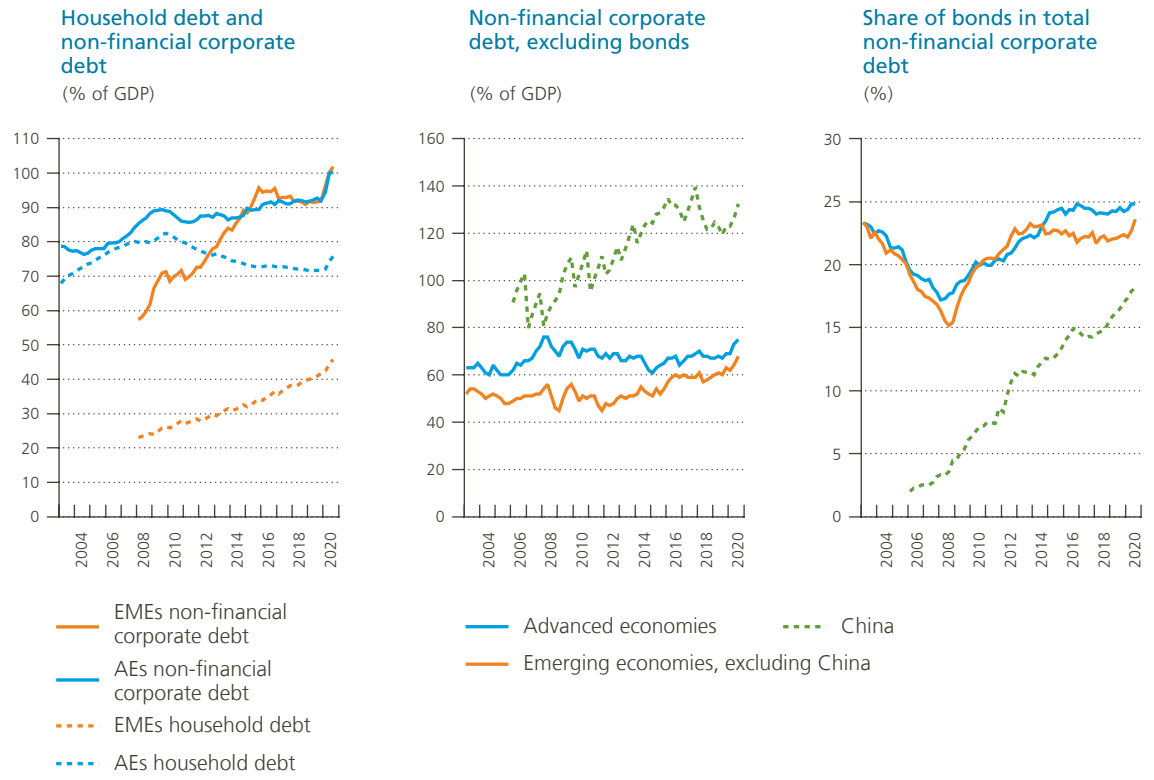
1 Estefania Flores *et al.* (2021) point out that medium-term public debt forecasts by the IMF and the private sector have systematically underestimated the actual evolution of debt, both in advanced economies (when the forecast horizon includes recessions) and in emerging economies (irrespective of the occurrence of recessions).

2 These fiscal packages are the American Rescue Plan ($ 1.9 trillion), the American Jobs Plan ($ 2.3 trillion), and the American Families Plan ($ 1.8 trillion). The latter two plans will be partly funded by higher taxes.

3 As of mid-March 2021, advanced and emerging economies' pandemic-related contingent liabilities (guarantees plus quasi-fiscal operations) were estimated by the IMF (2021b) at another $ 5.7 trillion. There are nevertheless large country differences in the extent to which these announced measures have actually been taken up, and these differences are mostly explained by the demand for liquidity by firms in the respective countries (in turn linked to countries' output losses during the COVID-19 crisis). For example, at the end of 2020, in Germany, only 9 % of the announced € 550 billion envelope of government-backed credit support programmes had been used, compared to 43 % of the € 300 billion envelope in France, 42 % of € 350 billion in Italy and 63 % of € 184 billion in Spain (Anderson *et al.*, 2021).

Chart 4

Recent growth in non-financial corporate debt mainly due to bond issuance and credit boom in China [1]



Source: BIS.

1 In the left-hand panel, advanced economies include the euro area and 10 other countries. Emerging market economies comprise 21 countries. The selection of countries included in the advanced and emerging economy aggregates differs in the middle and right-hand panels due to data availability. The aggregates in the left-hand panel are weighted by GDP in purchasing power parity terms; in the other panels, the aggregates are weighted by GDP based on market exchange rates.

household debt was at the very epicentre of the crisis. When the sub-prime housing bubble burst in the United States, it trickled down to other advanced economies where imbalances in housing markets were also abruptly corrected, leading to strong deleveraging of households. For those reasons, this part of the article focuses on non-financial corporate debt, both in advanced and emerging economies.

In advanced economies, the GFC was a turning point for non-financial corporate debt and, in its wake, debt only grew modestly from 2011 onwards. Debt in emerging economies on the other hand continued to grow strongly until the beginning of 2016, with a nearly 40 percentage point of GDP increase between 2008 and 2016, even surpassing debt ratios in advanced economies. The number of emerging economies' non-financial corporations raising debt also increased steeply after the GFC (a 5.5-fold rise between 2007 and 2016 according to Abraham *et al.*, 2020). Between 2016 and the beginning of 2020, some deleveraging took place in emerging economies, mainly in Chinese industrial sectors after 2018.

Already before the outbreak of COVID-19, several multilateral institutions warned for the risks associated with high firm indebtedness (Çelik *et al.*, 2019; IMF, 2019). They cautioned that the rising non-financial corporate debt levels could pose threats to financial stability, trigger or aggravate financial crises, and impair growth. COVID-19 has further exacerbated those already high debt ratios, triggering increases of respectively 8 and 10 percentage points of GDP in advanced and emerging economies since the end of 2019. In part, these large

increases can be explained by the sharp drop in the denominator (GDP) due to the economic downturn caused by the pandemic, but non-financial companies also took on more debt. Moreover, in the euro area, reliance on debt seems to have increased more for already highly-leveraged firms (ECB, 2021). Consequently, the current situation with very highly indebted non-financial companies remains surrounded by risks, which will be discussed in more detail in section 2.

Looking more closely to the composition of the strong increase in corporate debt, it appears that the post-GFC increase can mainly be attributed to a generally strong expansion in corporate bond issuance as well as a credit boom in China. Between 2008 and 2020, the share of bonds in total non-financial corporate debt increased significantly in both emerging and advanced economies. Without bond securities, the growth of the ratio of non-financial corporate debt to GDP would have been flat in advanced economies and would have increased only slightly in emerging economies (excluding China) (see chart 4, middle panel).

China's credit boom was responsible for most of emerging economies' corporate debt accumulation over the period studied. The policy response after the GFC led to a strong credit expansion there, through banks, shadow banks[1], and rapidly developing bond markets. In China, the growth of credit (particularly to state-owned enterprises and local investment vehicles) also played a significant role in explaining the growth of total debt, as it rose steeply to around 140 % of GDP in 2017. From 2018 onwards, excess capacity in sectors such as coal and steel was reduced (via restructuring operations and the liquidation of unprofitable companies in these sectors). Besides the strong increase in bank credit since 2008, the share of bonds in total non-financial corporate debt also increased enormously in China (from 2 % in 2006 to 18 % in 2020) (see chart 4, right-hand panel). The specific situation of China's corporate indebtedness is discussed in more detail in box 1.

1 In China, the shadow banking sector exists of both *banks' shadow*, i.e. bank activities that provide credit through money creation, but which circumvent regulatory restrictions and lending constraints by adopting non-standard accounting measures, and *shadow banks*, i.e. non-bank financial intermediaries that create credit through money transfer (see Sun, 2019).

BOX 1

What has driven the rise in China's corporate indebtedness?

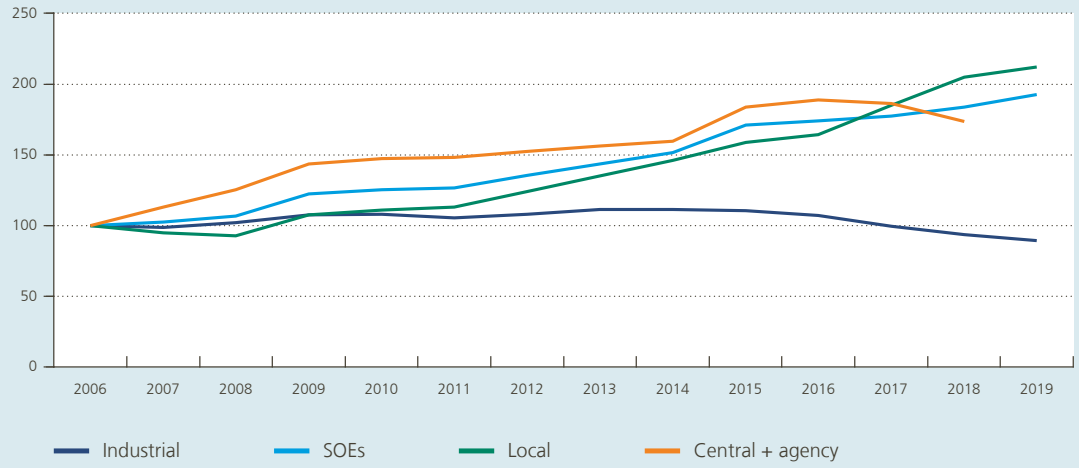
China's state-owned enterprises (SOEs) have contributed significantly to the build-up in corporate debt, with their debt-to-GDP ratio nearly doubling between 2006 and 2019 (see chart below). While the share of SOEs in the Chinese economy has declined continuously since 1978, they remain present in nearly every sector and are often dominant in sectors of strategic importance. They also account for most of China's corporate debt because they are perceived to be less risky compared to private firms and enjoy easier access to borrowing as a result. While no official statistics on the share of SOE debt in corporate debt have been published, two studies have estimated it at 63 % and 82 %, respectively, using different sources[1] (Molnar and Lu, 2019; Lam *et al.*, 2017). According to the OECD, the debt accumulation was concentrated in SOEs in the non-industrial sector (social services, transport and warehousing, real estate and construction) and SOEs owned by the local government (OECD, 2021a).

1 Molnar and Lu (2019) use data on all industrial firms provided by China's Ministry of Finance, whereas Lam *et al.* (2017) use data taken from the Chinese Wind database on all listed firms. Both estimates include the local government financing vehicles.

SOEs were also major actors in the implementation of China's RMB 4 trillion (or 14 % of GDP) fiscal spending plan of 2009 and 2010, which focused on infrastructure investment. They contracted most of the debts needed to finance such infrastructure projects. As the Chinese statistical classification assigns all SOEs to the corporate sector, the cost of the fiscal stimulus was reflected in sharply rising corporate debt instead of government debt, the latter remaining relatively low at around 40 % of GDP. In the case of the local government, which was responsible for three-quarters of the fiscal stimulus, new local SOEs were created to circumvent the strict legal prohibition (until 2014) on direct local government borrowing as specified in the 1994 Budget Law. This practice was sanctioned by the central government in its response to the GFC. These entities, better known as local government financing vehicles (LGFVs), receive capital, land or other public resources from their sponsoring local government and raise the required funding for public investment projects through bank loans and bond issuance, often with an implicit guarantee from the local government. The system of LGFVs illustrates that the boundary between the government and corporate sector debt is hard to draw in China.

Chinese state-owned enterprise debt by type [1]

(in % of GDP, converted to indices, 2006 = 100)



Source: OECD.

1 "SOEs" refer to non-financial enterprises and are defined as entirely state-owned firms and all firms with a controlling stake by the state in the form of an absolute or relative majority (Molnar and Lu, 2019). "Central" refers to SOEs represented by the State-owned Assets Supervision and Administration Commission (SASAC) or the Ministry of Finance including on behalf of the State Council. "Agency" refers to SOEs under direct control of central government agencies. "Local" refers to SOEs belonging to the local government level, including LGFVs. "Industrial" refers to SOEs in mining, manufacturing and utilities with sales of RMB 20 million or more.

When the fiscal stimulus ended in 2011, local governments were keen to continue using their LGFVs to channel financial resources toward favoured SOEs and private firms, with the hope of maintaining strong investment-led growth at the local level. As a result, LGFVs continued to build up debts. Alarmed by this trend, the central government introduced significant budget reforms in 2014 along with new restrictions on the use of LGFVs, but these measures proved unsuccessful in halting LGFV borrowing. Instead, they

induced the gradual transformation of LGFVs into special or designated investment platforms with more diversified asset portfolios, only 20 % of which flows to companies active in public services. The outcome has been a mixed success. While a certain degree of diversification can be a blessing for local economic growth, over-diversification is a curse (Fan *et al.*, 2021).

As Chinese monetary policy became less accommodative after 2010, many LGFVs that had initially borrowed heavily from banks came under refinancing pressures and were increasingly forced to rely on shadow bank loans and bond markets to roll over their debt and fund new investment (Chen *et al.*, 2020). This led to a deepening of the bond markets and an exponential take-off in shadow banking. These developments were moreover facilitated by earlier financial market deregulation, allowing for a broader range of financing instruments. Shadow banking also catered to the financial needs of real estate companies and less privileged – often smaller or more risky – private companies. All of this contributed to a further increase in corporate indebtedness, mirrored by ever-rising investment spending. In fact, the investment rate in China reached a peak of 46 % of GDP in 2014, which is very high by both China's standards and international comparison (Buysse *et al.*, 2018). Subsequent efforts to cut back on investment had the strongest impact on industrial sectors with substantial excess capacities, such as steel and coal, which saw some deleveraging.

A last factor that helps explain the rapid build-up of corporate debt in China is its low share of internally funded capital expenditure compared to other countries, possibly due to the combination of poor corporate earnings and aggressive capital investment (Ma, 2019).

What drove the strong increase in corporate bond issuance after the GFC ? Several factors can be identified, including tighter bank regulations, regulatory initiatives stimulating the use of bonds as a source of long-term funding, and very accommodative monetary policy in advanced economies.

In the wake of the GFC, many countries implemented stricter bank regulations to contain financial risks. These more stringent regulatory requirements (such as the Basel III standards) undoubtedly increased financial stability and the resilience of the financial system but also led banks to reduce leverage and become more prudent in their lending activities, particularly towards emerging economy borrowers (which carry more risk on average). These developments raised corporations' cost of bank loans, ultimately resulting in higher lending spreads compared to bond issuance and lower lending volumes (Abraham *et al.*, 2020, Slovik and Cournède, 2011 ; Noss and Toffano, 2016 ; Adrian *et al.*, 2017 ; Roulet, 2018).

At the same time, as mentioned above, accommodative monetary policy in advanced economies fuelled global investors' risk appetite. The very low interest rates after the GFC, combined with large asset purchase programmes (quantitative easing) by central banks in advanced economies, drove investors' search for yield. This search for yield reduced corporate bond spreads, even for high-yield firms, to very low levels (see chart 3, right-hand panel). Investors turned away from so-called safe assets in advanced economies towards riskier non-financial corporations' and emerging economy sovereign bonds. Following these developments, corporate bond issuance soared, particularly of large-denomination bonds (Burger *et al.* 2018). De Santis and Zaghini (2019) find a significant increase in the issuance of euro-denominated bonds of around 14 % as a consequence of the ECB's corporate sector purchase programme (CSPP). Lo Duca *et al.* (2014) show that US quantitative easing policies had a large impact on corporate bond issuance, particularly in emerging economies, and that

portfolio rebalancing effects were the main transmission channel. The implementation of quantitative easing programmes in several emerging economies in response to the COVID-19 crisis is likely to have further amplified these effects.

According to the traditional monetary policy transmission mechanism, lower interest rates should have also helped to make access to bank loans easier for businesses. Research by Alter and Elekdag (2020), for example, shows that a 1 percentage point reduction in the US Federal Reserve's policy rate seems to increase total (bank-based and bond debt) leverage in EME firms by 9 basis points. Similar research by the IMF shows that a one-unit relaxation of financial conditions[1] is followed by a (non-linear) increase in non-financial corporate debt of 4 percentage points of GDP over three years; this association becomes stronger in times of high credit growth and already loose financial conditions. The effects reported are broadly similar across advanced and emerging economies, though in the latter case, non-financial corporate leverage appears to react more strongly to financial conditions (IMF, 2021c).

However, the increase in bond issuance appears to have played a more important role than the increase in bank lending in explaining the rise in corporate debt. One reason could be that the effectiveness of the transmission mechanism has been somewhat hampered by the environment of very low interest rates (Borio and Gambacorta, 2017) and that the effect of regulatory changes, as mentioned above, has counterbalanced the positive effect of very low interest rates on the provision of bank credit (Hogan, 2019).

There is also evidence that speculative investment opportunities, such as carry trade, have fuelled bond issuance by non-financial corporations in emerging economies. In a carry trade, firms aim to profit from interest rate differentials in different markets by borrowing in a market where interest rates are low and then investing the proceeds in local bank deposits, shadow banking and/or other financial instruments in higher-interest rate markets (Bruno and Shin, 2016).

After the GFC, many firms seem to have used bond issuance to finance riskier activities, for which they would have less likely obtained bank credit (or at a higher cost). An increasing share of bond issuance was used for share buybacks, dividend payouts and mergers and acquisitions (M&A), particularly in the US (IMF, 2019; 2021c). Between 2015 and 2019, bonds used for payouts accounted for an average of 14 % of total investment grade issuance. A similar trend could be seen in the non-investment grade bond category, albeit at a somewhat lower level (11 % of total issuance) (Çelik *et al.*, 2020). When the COVID-19 crisis broke out, the search for liquidity also played a role in explaining the further rise in corporate debt. In the first phase of the crisis, which was characterised by extreme precaution and heightened aggregate risk, firms mostly drew down bank credit lines to raise cash levels. In the second phase, which followed the adoption of fiscal and monetary stabilisation policies, only the highest-rated firms switched to capital markets to raise cash (Acharya and Steffen, 2020). Once markets had stabilised, issuance also returned on a broader scale and for different motives. For example, since the third quarter of 2020, a strong rebound in corporate bond issuance backing M&A activity and leveraged buyouts has been visible in the data (IMF, 2021d).

Corporate bond issuance has also been supported by regulatory initiatives in many economies aimed at stimulating the use of corporate bonds as a viable source of long-term funding for non-financial corporations and an attractive asset class for investors. This has particularly been the case in emerging economies. Many of the measures taken have focused on improving access to primary markets by simplifying issuance regulations and reducing the costs and time involved in raising capital through bonds (IOSCO, 2011).

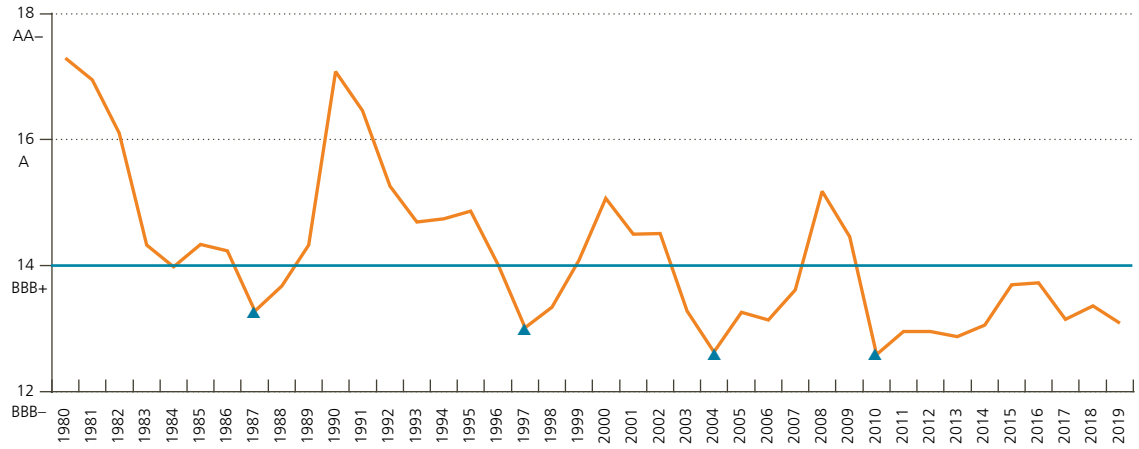
While the increase in bond issuance has led to more diversification in firms' sources of financing, the data shows that, in general, the quality of corporate bonds has been trending downwards for a long time (Çelik *et al.*, 2019; 2020, Lund *et al.*, 2018).

1 A one-unit decline in the financial conditions index is comparable to the average loosening in financial conditions observed across the economies in the sample between the end of 2020Q1 and 2020Q4.

Chart 5

The quality of corporate bonds issued had been declining long before COVID-19 [1]

(global corporate bond rating index)



Source: OECD.

1 The index assigns a score of 1 to a bond if it has the lowest credit quality rating and 21 if it has the highest rating. The corporate bond rating index is then calculated by taking a weighted average of individual bond scores, using issue amounts as weights.

The OECD constructed an index to provide a measure of overall bond quality rating. As shown in chart 5, this index displays a clear downward trend in the average rating of issued bonds since 1980. Moreover, the average corporate bond issued has been below BBB+ rating for nearly a decade, which is the longest period with a below-BBB+ rating since 1980. In all other credit cycles, the turning points, after which a deleveraging process took place, occurred much sooner.

Another commonly used measure of issuer quality is the share of non-investment grade issuance relative to total corporate bond issuance (Greenwood and Hanson, 2013; Çelik *et al.*, 2020). The share of non-investment grade issuance remained above 20 % in nearly every year since 2010 and was as high as 25 % in 2019. This was the longest period since 1980 that the portion of non-investment-grade issuance remained this high before there was a significant decline and default rates rose (Çelik *et al.*, 2020). In the first few months of the pandemic in early 2020, there was a temporary increase in investment-grade issuance, as investors turned back to safer assets, but issuance returned to earlier trends by the end of the summer of 2020.

Within investment and non-investment grade categories, changes have also taken place, with an increasing share of BBB-rated bonds (the lowest rating for investment-grade bonds) being issued in the investment-grade category. In 2019, their share accounted for slightly over half of all investment-grade issuance, compared to 39 % on average during the period 2000-2007. On the other hand, credit quality has shifted in the opposite direction in the non-investment-grade category, with 59 % of issuance accounted for by BB-rated bonds (the highest rating for non-investment grade bonds), compared to 35 % on average in the period 2000-2007. This may be partly attributable to the fact that, in recent years, some issuers with below-BB ratings have left the bond market for the leveraged loan [1] market (Çelik *et al.*, 2020).

This increased issuance of BBB-rated bonds, non-investment-grade bonds and bonds from emerging economy corporations has led to a situation where lower credit quality bonds now make up the bulk of the global

1 There is no fixed set of rules or official criteria to define a leveraged loan, but it is generally a type of loan that is extended to companies or individuals that already have considerable debt or poor credit history, making them more likely to default.

outstanding stock of bonds. As institutional investors are often bound or restricted by investment mandates, regulations and policies to only hold investment-grade bonds, extensive downgrades of BBB-rated bonds as a consequence of the current crisis could lead to significant sell-offs, putting corporate bond markets under stress. The long-term decline in bond quality, combined with the problems caused by the COVID-19 pandemic, thus carries risks and may result in higher default rates than in previous credit cycles.

2. Risks of high debt

2.1 The risks associated with high public debt

2.1.1 Public debt and economic growth

In the literature on the relationship between public debt and economic growth, an influential theory is that of public debt overhang (Reinhart *et al.*, 2012): high public debt ultimately leads to lower economic growth since investable funds are redirected from private initiatives towards financing the government, and/or because of the distortive tax (or other) policies that need to be implemented to be able to repay the debt later (which further undermines private investment). Although the overhang theory does certainly not apply under all circumstances, there is indeed empirical evidence at the sectoral and firm level, for both advanced and emerging economies, which suggests that public debt crowds out corporate investment by tightening credit constraints (Huang *et al.*, 2018; 2020).

Another prominent argument linking high public debt to lower growth posits that a government carrying a high debt load may be constrained in conducting countercyclical policies and responding to future shocks, such as financial crises, natural disasters or a pandemic (Yared, 2019). The absence of policy room leads to more volatile and, in the longer run, lower economic output; hence the need to "keep the powder dry" (Obstfeld, 2013) and build buffers during economically more advantageous times. For a sample of 30 OECD countries over the 1980-2017 period, Romer and Romer (2019) demonstrate that those countries with lower public debt ratios responded to financial distress with much more expansionary fiscal policy and suffered significantly less severe aftermaths, both because of fewer problems with market access and policy-makers' deliberate policy choices on the fiscal stance.

If we look at countries' fiscal policy responses during the COVID-19 crisis, however, we notice that even advanced economies with high public debt appear not to have been hindered in their use of large fiscal support measures[1]. Of course, the exceptionally large fiscal response to COVID-19 was heavily supported by a further easing in the monetary policies conducted by advanced economy central banks, which kept borrowing costs down and hence safeguarded fiscal space[2] (see Cornille *et al.*, 2021 in this issue of the Economic Review). Moreover, since the start of the crisis, European countries have enjoyed fiscal support (or the prospect thereof) from several EU initiatives, such as SURE, Next Generation EU and adaptations to the EU longer-term budget[3]. While there may be no simple relationship between countries' public debt ratio and the size of their COVID-19

1 The observation that emerging economies' fiscal responses have been much more tepid may derive from their higher "debt intolerance" (see section 2.1.3), i.e. a country like Argentina had much lower fiscal space to fight the COVID-19 crisis than say Spain, despite having a similar public debt ratio.

2 Throughout this article, we use the term "fiscal space" as defined by Heller (2005): "the room in a government´s budget that allows it to provide resources for a desired purpose without jeopardising the sustainability of its financial position or the stability of the economy". Similarly, fiscal space can be seen as the difference between the current public debt ratio and some estimated "debt limit" beyond which fiscal solvency is in doubt, i.e. beyond which market access would be lost, the government is unable to rollover its debt, and could ultimately default (Ghosh *et al.*, 2013; see section 2.1.2).

3 The temporary Support to mitigate Unemployment Risks in an Emergency (SURE) is a € 100 billion instrument set up in May 2020 to provide loans to EU Member States to address sudden increases in public expenditure for the preservation of employment. Next Generation EU is the EU's front-loaded € 750 billion COVID-19 recovery package (€ 390 billion of which is available as grants) conceived in July 2020. At the core of Next Generation EU is the € 672.5 billion Recovery and Resilience Facility (RFF) aimed at helping Member States address the economic and social impact of the COVID-19 pandemic, while ensuring that their economies undertake green and digital transitions. In order to receive RFF support, EU countries are asked to set out a coherent package of projects, reforms and investment until 2026.

fiscal stimulus, Apeti *et al.* (2021) find that governments with lower pre-COVID debt-to-tax ratios or higher sovereign credit ratings (two alternative measures of fiscal space) did implement larger fiscal support packages, especially so in advanced economies.

More generally, empirical studies tend to find a negative correlation between public debt ratios and economic growth. But because of their two-way relationship (as slow growth pushes up the public-debt-to-GDP ratio by definition), the abundance of possible confounding variables giving rise to the observed negative association, and likely non-linearities, it is far from straightforward to establish clear causality from higher public debt to lower growth (see Panizza and Presbitero, 2013 for a survey). Today, most experts tend to agree that there is no universal threshold, common for all countries (or even just for all advanced economies), beyond which public debt has an unambiguously negative impact on growth. This stands in contrast to the 90 %-of-GDP public debt threshold that has often been advanced by policy-makers, based on a highly influential paper by Reinhart and Rogoff (2010)[1]. Rather, if there is actually a non-linear relationship between public debt and growth, it varies from country to country (Eberhardt and Presbitero, 2015). Moreover, recent studies indicate that the trajectory over time of the public debt ratio may be more important for growth than the level of the public debt ratio itself (Pescatori *et al.*, 2014; Chudik *et al.*, 2017).

Chart 6 illustrates the absence of a "magic" public debt threshold with respect to growth. Each dot represents one data point, i.e. the public debt ratio of a specific country in a specific year between 1980 and 2019 and the associated real economic growth of that country in that year (expressed as the deviation from the country-specific period mean of GDP). The result is a highly scattered cloud of data points. While there may be an overall negative debt-growth relationship at extreme levels of public debt, the country-specific correlations are very heterogeneous and no universal threshold or turning point is observed[2].

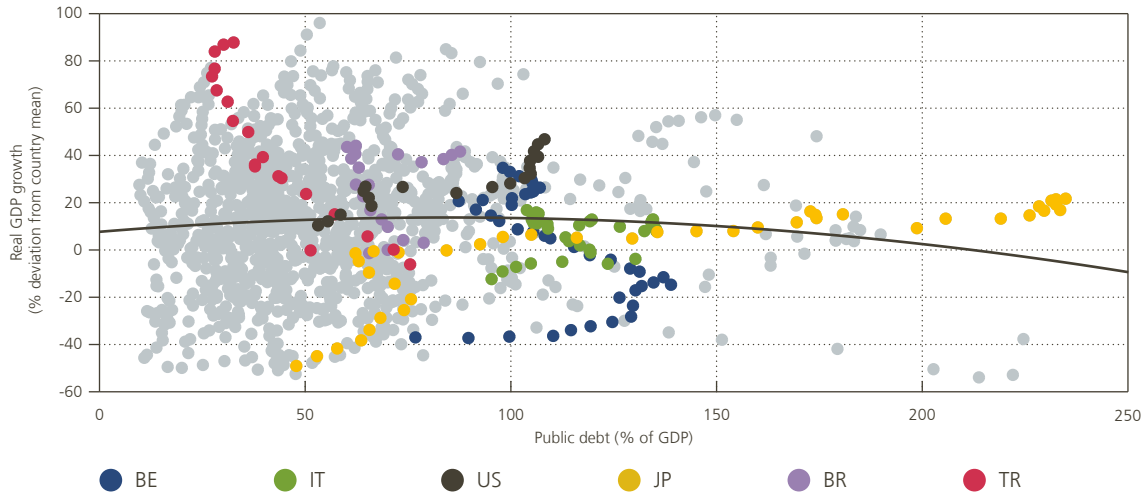
1 It should be noted that policy-makers referring to Reinhart and Rogoff (2010) have often adopted a much stricter interpretation of the results than intended by the authors of the paper.

2 Scatter plots of the relationship between public debt and future (say, five-year-ahead) growth lead to very similar conclusions (see Fatas *et al.*, 2020).

Chart 6

There is no "magic" public debt threshold

Public debt vs. economic growth [1], 1980-2019



Sources: IMF; methodology based on Eberhardt and Presibitero (2015).

1 Sample includes 47 advanced and emerging economies and is unbalanced in terms of years. Countries with a population smaller than 5 million (in 2020) are excluded, as are fuel exporters, fragile states, countries undergoing fast structural changes (Asian Tigers) and extreme outliers.

Ultimately, the growth effects of public debt also depend on what the proceeds are used for, and thus on the motives underlying governments' borrowing. While it is not always possible to make a clean separation between the "good, the bad and the ugly", the literature distinguishes between a couple of common borrowing motives (see Yared, 2019; Fatas *et al.*, 2020; and Kose, Ohnsorge *et al.*, 2020 for a more complete treatment).

Among the "good" reasons for accumulating debt, we find the financing of temporary countercyclical (demand-supporting) fiscal policy, as well as of investment boosting the economy's potential output (and therefore with a likely beneficial effect on the public debt ratio). Also, by financing large and lumpy public investment by means of extra (longer-term) debt issuance, governments can smooth taxes over time and thereby avoid the distortionary costs to the economy of having to ramp up taxes quickly and sharply. Of course, this reasoning supposes that debt accumulation now is being compensated by debt reduction later, during tranquil periods (through higher economic growth and/or primary fiscal surpluses). Even the small set of governments (typically of financial centres and resource-rich countries) which may not need to borrow to meet their financing needs – because they run persistent fiscal surpluses – still choose to issue debt. In these cases, public debt is issued to provide the banking sector and financial markets with a safe, "risk-free" asset that can serve as a savings vehicle and as a benchmark from which other (more risky) financial instruments such as corporate bonds or derivates can be priced (Kumhof and Tanner, 2005).

Obviously, public debt accumulation sometimes derives from "bad" or at least "less good" motives, mostly rooted in political economy. One example is that of political budget cycles, where politicians use government debt to finance tax cuts and spending increases that are primarily aimed at improving re-election chances. The empirical cross-country evidence in fact suggests that such cycles do exist, but their importance varies along different political systems, the degree of fiscal transparency and other factors (Philips, 2016). Another possibility is that public debt is used to redistribute too many resources (relative to the social optimum) from younger and future generations to the current, older generation, which may be more successful in asserting their preferences for the here and now. Such dynamics are especially expected in countries with more rapidly ageing populations, in which the median voter shifts to older cohorts (Yared, 2019). Finally, part of the government's over-borrowing may be due to common pool problems, such as when different line ministries each present a budget that appeases their respective pressure groups and the Finance Ministry is then confronted with an overall budget that is sub-optimally large from a macroeconomic point of view (Fatas *et al.*, 2020).

2.1.2 Public debt sustainability, safety and a negative r-g

Regardless of its nexus with economic growth, public debt needs to be "sustainable". Public debt sustainability is a complex concept and there are various definitions for it. Arguably one of the most complete definitions, covering both solvency and liquidity requirements, is that of the IMF (2021e, p. 6): "*[i]n general terms, public debt can be regarded as sustainable when the primary balance needed to at least stabilise debt under both the baseline and realistic shock scenarios is economically and politically feasible, such that the level of debt is consistent with an acceptably low rollover risk and with preserving potential growth at a satisfactory level*". Put differently, if stabilising the public debt ratio requires that, over an extended period, the government needs to achieve fiscal surpluses that are so large that they would not be acceptable to citizens and/or financial markets, or would imply austerity that significantly shrinks the economy, then public debt is considered unsustainable. Of course, the assessment of debt sustainability is more art than science. It is an inherently forward-looking exercise involving judgement, which depends on the government's strategic choices and fickle financial market beliefs; a broad, hard-to-model constellation of potential shocks hitting the government's balance sheets; and the composition and ownership of debts (Debrun, Ostry *et al.*, 2020; see also section 2.1.3).

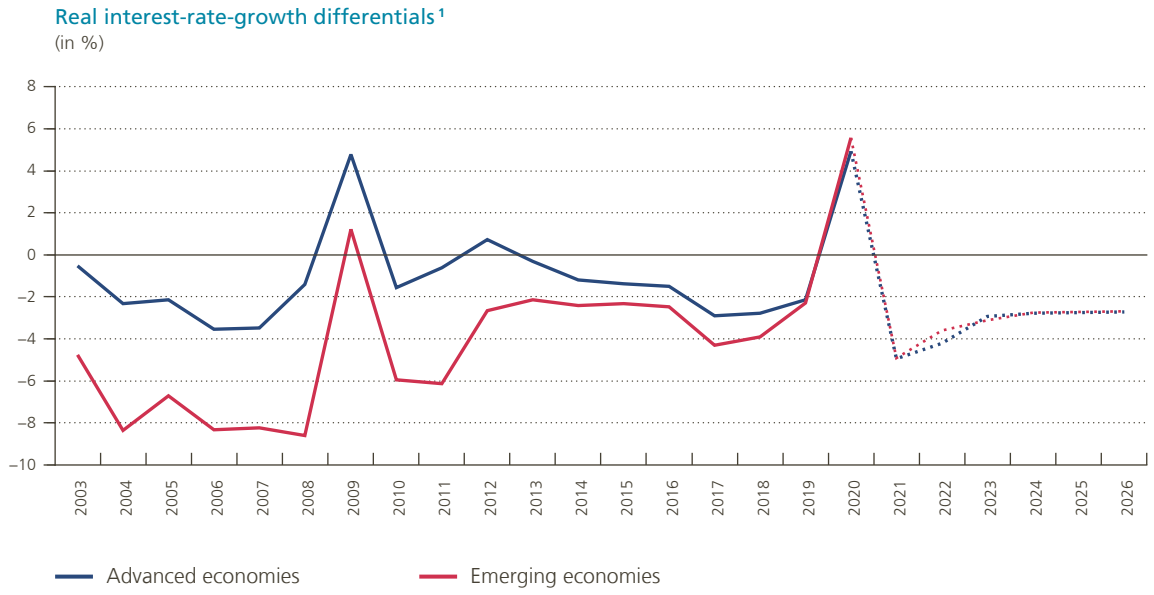
The government may want to steer clear from its maximum sustainable public debt ratio or "debt limit", beyond which it loses market access, is unable to rollover its debt, and could be forced to default (Ghosh *et al.*, 2013; Collard *et al.*, 2015). Since growth, primary balances, interest rates and (most relevant for emerging economies) exchange rates are all subject to (often correlated and persistent) shocks, it makes sense to keep public debt within a safety zone below the debt limit. A "safe" public debt level means that policy-makers are able to retain control over debt dynamics using fiscal policy, even under adverse conditions (Debrun, Jarmuzek *et al.*, 2020).

To be sure, and as suggested by the above definition, public debt sustainability analyses by the IMF, European Commission and others not only consider metrics based on the overall debt stock but also gross financing needs, i.e. the sum of the budget deficit plus any maturing public debt. Ceteris paribus, larger gross financing needs imply greater refinancing risks but, again, country characteristics, such as the size and depth of countries' domestic financial sector and markets and the composition of the broader public debt investor base, matter (IMF, 2021e; see section 2.1.3).

Recently, because of the very low interest rate environment (see section 1.2), there has been much discussion about negative interest-rate-growth differentials and what this means for public debt dynamics and sustainability. As chart 7 shows, advanced, and even more so, emerging economies have generally seen negative "r-g" over the past decade, except during the major recessions associated with the GFC and COVID-19 crisis; a constellation which is expected to continue over the medium term. When real economic growth exceeds the real cost of government borrowing, the government can just infinitely roll over its debt, and the debt ratio will automatically decline without having to achieve primary surpluses. The beneficial effect of negative r-g is moreover larger in countries where the initial public debt ratio is higher. Does this mean that we can sleep more soundly (Mauro and Zhou, 2021), while we patiently wait for the current record levels of public debt to melt away?

Chart 7

Negative r-g: not so uncommon, but not a law of nature



Source: IMF.

1 Interest rate is here the implicit interest rate on public debt expressed in real terms, i.e. the ratio of the interest bill to the debt stock that was outstanding in the previous year. Advanced and emerging economy aggregates are simple averages based on samples of 20 and 22 countries, respectively. Dotted lines represent IMF forecasts as of April 2021.

According to some, notably Blanchard (2019) and Furman and Summers (2020), negative r-g is part of a "new normal" of persistently low interest rates for (many) years to come, at least for major advanced economies[1]. Under such circumstances, public debt has no fiscal and low welfare costs, opening up possibilities for more

1 Private sector forecasters tend to hold similar views. According to the April 2021 survey of Consensus Economics, average real GDP growth over 2027-2031 is projected to exceed real (10-year) interest rates in all G7 economies apart from Italy.

aggressive fiscal stabilisation policies and large public investment programmes. The standard public-debt-to-GDP ratio is considered a misleading measure of debt sustainability, since low interest rates imply that the present value of future GDP has risen while debt service costs have fallen.

Others have a (much) less optimistic reading of negative r-g. Cochrane (2021) points out that the foregoing logic only holds if the extra fiscal expansion and accumulation of public debt do not lead to any increase in the interest rate and/or to lower growth (through higher risk premia and crowding out of private investment). He also demonstrates that, whereas r < g may indeed finance small fiscal deficits, the public debt ratio may not stabilise or only at very high ("unsafe") levels when fiscal deficits are too large[1].

Moreover, negative r-g is hardly a "new" phenomenon. Using data from 1800 up to 2018, Mauro and Zhou (2021) show that negative interest-rate-growth differentials have occurred over long periods in history in both advanced and emerging economies. On average, the share of years with negative r-g was 61 % and 75 % in advanced and emerging economies, respectively (and 100 % in China !). Often, this setting was the result of financial repression, i.e. situations where the (real) borrowing cost of the government was kept artificially low by means of interest rate controls, high reserve requirements for banks, international capital controls and/or publicly owned banks. While advanced economies liberalised their financial markets and fought inflation in the 1980s, emerging economies continued to practise financial repression against a high-inflation backdrop until the mid-1990s, explaining the higher prevalence (and typically higher absolute value) of negative r-g in the latter group of countries. Clearly, the historical norm of negative r-g has not always led to falling public debt ratios, except in the aftermath of World War II (see chart 1). As Rogoff (2021) quips, "politicians have long learned how to spend more than the growth-interest dividend".

Although it may not be the baseline scenario, the risk of a (sudden) reversal in r-g should not be discarded. Such reversals have been observed on several occasions in the past, especially in countries with higher public debts, shorter debt maturities and larger shares of debt denominated in foreign currency, which may be more vulnerable to rises in risk premia when growth falters or global risk aversion increases (Lian *et al.*, 2020). Higher public debt also implies a greater adverse snowballing effect, should r-g flip to being positive. Especially in emerging economies, where interest rates and growth are typically more volatile, negative r-g is far from guaranteed over the longer run. The scope for fiscal adjustment in the face of higher rates or lower growth is also smaller in emerging economies, because of smaller tax bases and lower non-interest shares of government expenditure. Blanchard *et al.* (2021) therefore warn against "importing wholesale the new fiscal consensus" from advanced to emerging economies[2].

Mauro and Zhou (2021) further demonstrate that r-g values have little predictive power when it comes to signalling debt problems: r-g values do not look significantly different in the years prior to default than in "normal" times. Conversely, marginal interest rates (i.e. the cost of newly issued public debt) tend to spike in the run-up to payment problems, typically only a few months ahead, leaving little time for corrective policies. According to the analysis of Moreno Badia *et al.* (2020), the public debt ratio itself is the most important predictor of fiscal crises, showing strong non-linearities but irrespective of interest rate-growth differentials.

One way in which governments can shield themselves against the risk of rising borrowing costs is the lengthening of debt maturities, which is exactly what Belgium and several other OECD countries have been doing in recent years (Cornille *et al.*, 2019)[3]. The current low-interest-rate environment makes such maturity lengthening financially attractive.

1 For illustrative scenarios of such public debt dynamics in Europe, see Fuest and Gros (2019). For applications to the Belgian context, see Cornille *et al.* (2019) and Cornille *et al.* (2021).

2 Euro area and other currency union member countries should remain particularly cautious too, given that their control over interest rates is more limited than in economies that have their own currency.

3 The COVID-19 crisis has been accompanied by a (likely temporary) return to more short-term bond financing (OECD, 2021b). The broader literature confirms that average bond maturities tend to decline during crises and periods of distress (Mitchener and Trebesch, 2021). Part of the debt maturity lengthening efforts by governments has been countered by increased central bank purchases of government debt, which have shortened the effective maturity of the consolidated public sector debt (see section 2.1.3).

All in all, we can argue that negative interest rate-growth differentials provide extra breathing room to continue to fiscally support the economy as it recovers from a severe crisis, and opportunities for financing larger public investments without driving up the public debt ratio (too much). Yet, this does not imply that "anything goes". A negative r-g should not be used as a free pass to waive all budgetary discipline or to lose sight of the evolution of the public debt stock.

2.1.3 Heterogeneity in investor bases and debt tolerance

As mentioned earlier, the composition of the public debt investor base is also relevant for borrowing costs and debt sustainability. Chart 8 illustrates that the holdership of public debt differs significantly between countries. A country like Belgium, for example, has a relatively diversified investor base, attracting foreign creditors from inside as well as outside the euro area, including banks, non-bank financial institutions such as pension funds and insurance companies, and investment fund managers, as well as foreign central banks (which include Belgian bonds in their reserve portfolios since they are denominated in euro, the second most commonly held reserve currency, after the US dollar). Naturally, in large countries with well-developed financial sectors and deep domestic financial markets, such as the United States and Japan, the role of resident investors is more prominent (even though, in absolute terms, both countries remain key suppliers of global reserve assets). The same goes for large, financially closed economies like China and India, where stringent restrictions on the international mobility of capital still apply. In other, smaller and more financially open emerging economies, including Argentina and Turkey, foreign creditors represent a larger share of the overall public debt holdership[1].

Wider foreign participation in public debt markets is a double-edged sword. On the one hand, foreign creditors can add to the available funding pool for governments, reducing the crowding-out effect of public debt on domestic banks' private sector credit portfolios, and contribute to higher liquidity and lower costs of marketable government debt. On the other hand, foreign (private) investors in public debt tend to be flightier and exhibit more procyclical behaviour than domestic investors (Arslanalp and Tsuda, 2012; 2014). Benchmark-driven investors, in particular, can expose countries to external shocks that are unrelated to their macroeconomic fundamentals (Arslanalp and Tsuda, 2015; Raddatz *et al.*, 2017).

In most advanced economies, especially the major ones, we observe in recent years a clear increase in the share of public debt that is held by the domestic central bank (or, in the case of the euro area, by the Eurosystem, since the start of the public sector purchase programme – PSPP in January 2015), mostly at the expense of other domestic investor shares. A larger central bank share in public debt holdings has again pros and cons. An important advantage is that, because of central banks' price and financial stability mandates, they take a longer-term perspective and tend to hold to maturity, thereby acting as stabilising investors which lower the refinancing risks for the government (Lennkh *et al.*, 2019). However, a key disadvantage is that the increase in central bank participation corresponds with a swap of traditional public debt for central bank liabilities under the form of bank reserves which have an overnight maturity; therefore the effective maturity of the consolidated public sector debt is shortened (see Cornille *et al.*, 2021 in this issue of the Economic Review for a detailed explanation of this mechanism). Moreover, since interest rate changes directly feed into the profits of the central bank (and thus impact the latter's redistribution of profits to the government), higher central bank ownership implies a larger risk of fiscal stress for the government when interest rates go up and/or greater risks for central bank independence (if the government does not accept the higher market interest rate and puts pressure on the central bank to keep its policy rates low).

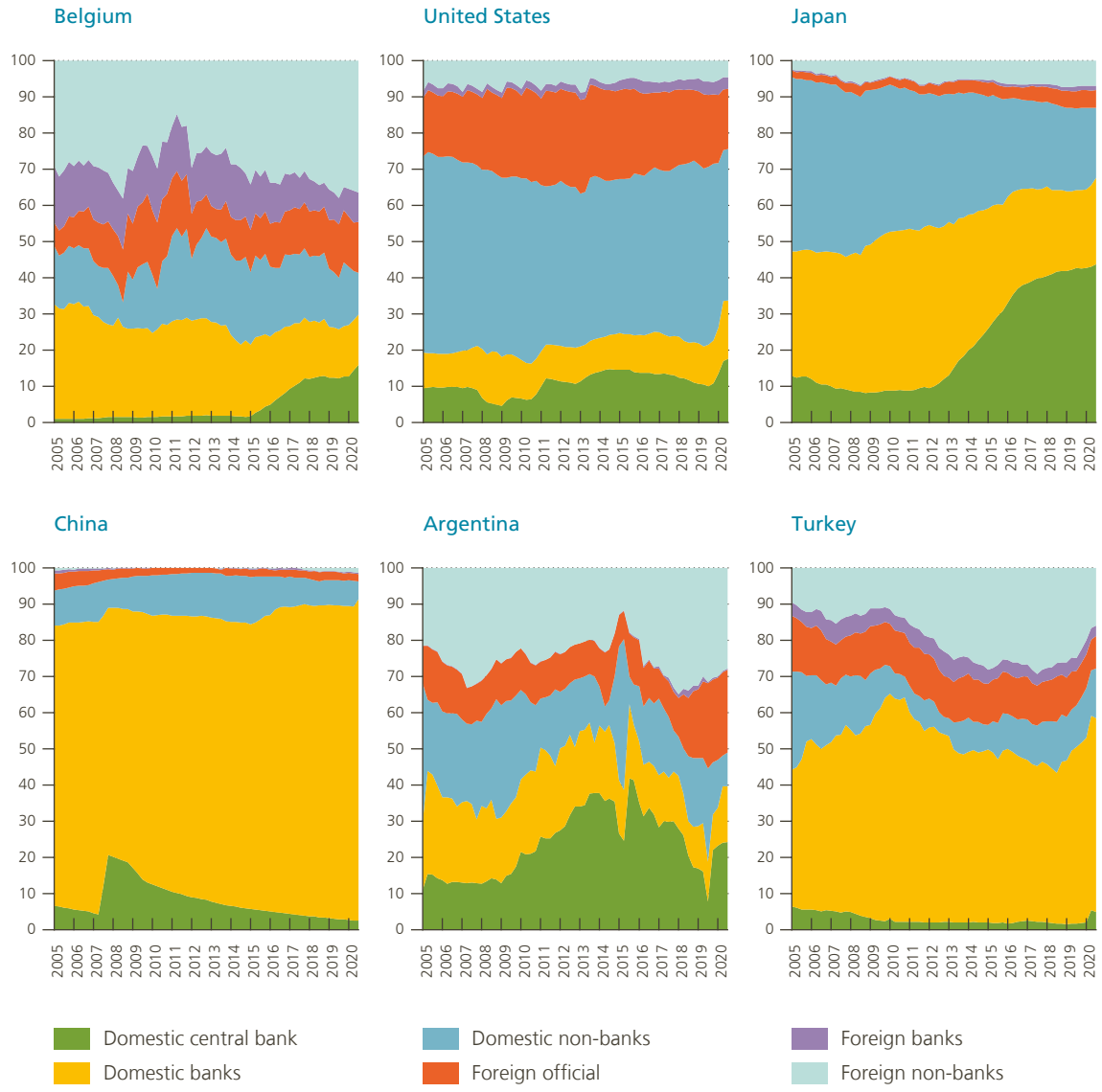
Apart from the investor base, the currency in which public debt is denominated also matters for debt sustainability. Most emerging economies have gradually enhanced the resilience of their public debts to shocks by borrowing more in local currency, something that was very difficult and costly before (as per the "original

1 Rather than foreign central bank holdings, the "foreign official" category comprises mostly a large IMF loan in Argentina, and World Bank and other multilateral support in Turkey.

Chart 8

Some public debt investor bases are more diversified than others

Holders of public debt[1], 2005-2020Q3
(in % of total public debt)



Sources: Arslanalp and Tsuda (2012, 2014).

1 Category of domestic central bank includes Eurosystem holdings for Belgium. Foreign official category consists of foreign central bank holdings and, in the case of Argentina and Turkey, foreign official loans from the IMF, World Bank and other multilateral organisations.

sin" theory[1]; see Eichengreen and Hausmann, 1999). Since the East Asian crisis (and other crises where foreign currency liabilities played an important role), emerging country governments have made deliberate efforts to develop domestic local currency bond markets. Over time, these domestic bond markets have caught the

1 The original sin theory starts from the observation that most countries (except for reserve-issuing countries) have been unable to use their own currency when borrowing from abroad (or even to borrow long term domestically) and posits that the main reasons behind this are beyond the control of individual countries: global financial market frictions and fragmentation, giving rise to high international transactions costs, and network externalities.

attention of foreign investors too. Unfortunately, the COVID-19 crisis has demonstrated that borrowing in their home currency does not isolate emerging economy governments from global financial shocks. In fact, when emerging economies borrow in local currency from abroad, the currency mismatches are shifted from the debtor to the foreign creditor: since those foreign creditors assess their returns in hard currency (typically US dollar) terms, local currency exchange rate depreciation amplifies creditor losses and may give rise to a local currency bond sell-off (a phenomenon called "original sin redux"; see Carstens and Shin, 2019). Due to the aggravating impact of this exchange rate channel, emerging country governments with higher foreign ownership in their local currency bond markets saw significantly larger increases in their local currency bond spreads during the early months of the COVID-19 pandemic (Hofmann *et al.*, 2020).

Summing up, not all debts and debtors are created equally. Countries differ in terms of the public debt levels they can support. Emerging economies and advanced economies with weaker macroeconomic fundamentals tend to have a higher "debt intolerance", meaning they experience problems (such as rapidly rising borrowing costs) at public debt ratios that are perfectly manageable by major advanced economy standards (Reinhart *et al.*, 2003). This higher debt intolerance appears to be explained by countries' historical track record of default and inflation, (perceived) institutional quality, as well as their debt investor base and structure (which are often intimately linked to countries' financial history and institutional set-up). Short-term, foreign-currency-denominated and externally-held debt is typically riskier, having predictive power for debt distress and crises (Manasse and Roubini, 2009; Catao and Milesi-Ferretti, 2014).

2.2 The risks associated with high corporate debt

Although there are several good reasons for non-financial corporations to rely on debt financing, such as to lessen agency problems between managers and shareholders, to diversify financing sources, to avoid diluting the owners' existing equity positions, or just because equity is not easily available to them, there are also several risks involved, such as the fact that debt needs to be serviced at all times, irrespective of the stance of the business cycle prevailing at the time. From an aggregate perspective, high firm indebtedness can have negative effects on financial stability and economic growth, which are interrelated. The relationship between corporate indebtedness and growth is generally considered to be inverse U-shaped, where very high debt levels are unfavourable for growth. However, as with public debt, there is no universal threshold that applies to all situations and the relationship seems to be characterised by non-linearities.

The negative relationship between high financial leverage and economic growth is often explained by a corporate debt overhang leading to reduced investment. Growing corporate debt could also be detrimental for economic growth if the new capital raised is misallocated toward relatively less productive firms, resulting in lower productivity and growth in the aggregate economy.

Besides its direct link to economic growth, high corporate indebtedness also increases solvency[1], currency, and rollover risks, which can lead to higher non-performing loans and, if realised on a large scale during crises, even risks to financial stability.

Lastly, although fiscal support allocated during the COVID-19 crisis has been absolutely essential and has helped many viable companies to withstand the economic adversities, the large-scale government guarantees for loans bring with them the risk of corporate debt ending up on governments' balance sheets, aggravating existing risks on already high public debt burdens discussed in the previous section.

2.2.1 Corporate debt overhang and misallocation of resources

COVID-19 is expected to have pushed up the number of non-financial firms in distress, defined as firms having a negative book value of equity (Demmou *et al.*, 2021). At the same time, firms have massively taken up more

1 For a detailed discussion of the effects of COVID-19 on Belgian corporate liquidity and solvency, see Tielens *et al.* (2021) in this issue of the Economic Review.

debt to bridge the acute crisis phase. These two factors have strongly raised corporate leverage (defined here as debt to total assets) and default risks. Empirical research shows that periods of strong growth in corporate financial leverage have often been followed by lower output growth (IMF, 2021c). This mainly works through the corporate "debt overhang" channel (Myers, 1977), where high financial leverage reduces firms' investment and ultimately economic growth.

Whenever a firm has a high outstanding debt stock and the risks of default are substantial, any return on investment will accrue relatively more to senior debt-holders than to shareholders. Therefore, the firm will only invest if the expected return from investment is higher than the debt service on outstanding debt held by senior creditors and can still offer attractive returns to new investors and equity holders. The investment decision consequently changes for highly indebted firms : having a positive net present value might no longer suffice to undertake the investment. Moreover, highly indebted companies may have more limited access to new credit, which, together with the reduced incentives to invest, can generate further pressure to deleverage and postpone or cancel even profitable investment (Demmou *et al.*, 2021). Ultimately, this lower investment can undermine output growth and the economic rebound after a crisis. The prolonged period of low investment after the GFC has clearly demonstrated this risk should not be underestimated (Kalemli-Özcan *et al.*, 2019).

Recent research has added further nuance to the corporate debt overhang theory. Barbiero *et al.* (2020) find that corporate debt overhang is less pronounced for firms in sectors with good global growth opportunities, while Diamond and He (2014) and Kalemli-Özcan *et al.* (2019) demonstrate that it is larger for short-term debt in bad times. Borenszstein and Ye (2020) find that corporate debt overhang is stronger for large firms. Kalemli-Özcan *et al.* (2019) show that it is stronger when firms are linked to weak banks with exposure to sovereign risk, something which has played a role in the aftermath of the European sovereign debt crisis. Evidence also points to non-linearities in the relationship between high corporate indebtedness and investment activity at firm level, in which debt overhang discourages investment more strongly when corporate leverage is higher (Borensztein and Ye, 2020 ; Cevik and Miryugin, 2020).

The COVID-19 crisis will most likely lead to debt overhang problems, as the hardest-hit sectors often do not offer favourable business prospects and corporate leverage is at record levels and still growing. The combination of high indebtedness and reduced profitability raises default risks and there is a significant amount of new short-term debt to bridge the period of reduced economic activity. Consequently, there is a real risk of a prolonged period of low investment and low growth, particularly in certain sectors, if the effects of the pandemic linger and if the recovery from the downturn takes longer than expected (Cevik and Miryugin, 2020).

As mentioned above, high and growing corporate debt levels can also undermine growth if the new capital raised is misallocated, leading to lower aggregate productivity growth. This misallocation of resources can happen through intra-firm or inter-firm efficiency channels.

Within firms, one of the reasons why firms might prefer debt over equity, is the existence of a debt-equity tax bias (Fatica *et al.*, 2012). Interest payments are tax deductible in most corporate income tax systems while typically no such treatment is foreseen for equity financing[1]. This creates a distortion in the financing decision of companies, as they are inclined to take on more debt than without such measures, which exacerbates the risks associated with high leverage. The IMF (2016) estimates that the debt bias in corporate tax systems could have pushed up debt ratios by on average 7 % of total assets.

Besides the intra-firm efficiency channel, misallocation of resources across firms can equally lead to lower aggregate productivity. For example, research has shown that, in periods with strong credit expansion, credit flows disproportionally to companies with more (tangible) or better collateral (e.g. firms with more real estate assets during the initial years of a real estate boom, see Martin *et al.*, 2019), undermining growth in

1 Allowances for corporate equity to (partially) correct for this discrimination between sources of financing exist in several countries, including Belgium, Brazil, Cyprus, Italy, Malta, Poland, Portugal and Turkey.

industries that have more intangible assets (e.g. as a result of high R&D intensity), i.e. what are commonly considered the engines of growth. In such instances, these firms will have less access to credit, undermining the overall productivity growth of an economy (Cecchetti and Kharroubi, 2015). Having better access to credit also allows less efficient incumbent firms to remain longer on the market, thereby discouraging entry of new and potentially more efficient innovators (Aghion *et al.* 2019). The effects may also play out through the demand for labour : credit booms tend to undermine productivity growth by inducing labour reallocations towards sectors with lower productivity growth. Moreover, the effect of misallocations that occur during a credit boom, and during economic expansions more generally, is much larger if a crisis follows (Borio *et al.*, 2015).

2.2.2 Solvency risks

Solvency is defined as the ability of a company to generate enough revenue to service its debt. As mentioned above, the COVID-19 crisis has placed a lot of stress on firms' assets, even leading to negative book values of equity for many firms. In particular (but not only) for the latter firms, it may be difficult to generate enough cash flow to meet their debt service requirements, after which insolvency and bankruptcy loom just around the corner. The sharp contraction in economic activity caused by the lockdowns and other measures in response to COVID-19 was therefore expected to increase insolvencies soon after the first wave of the pandemic kicked in.

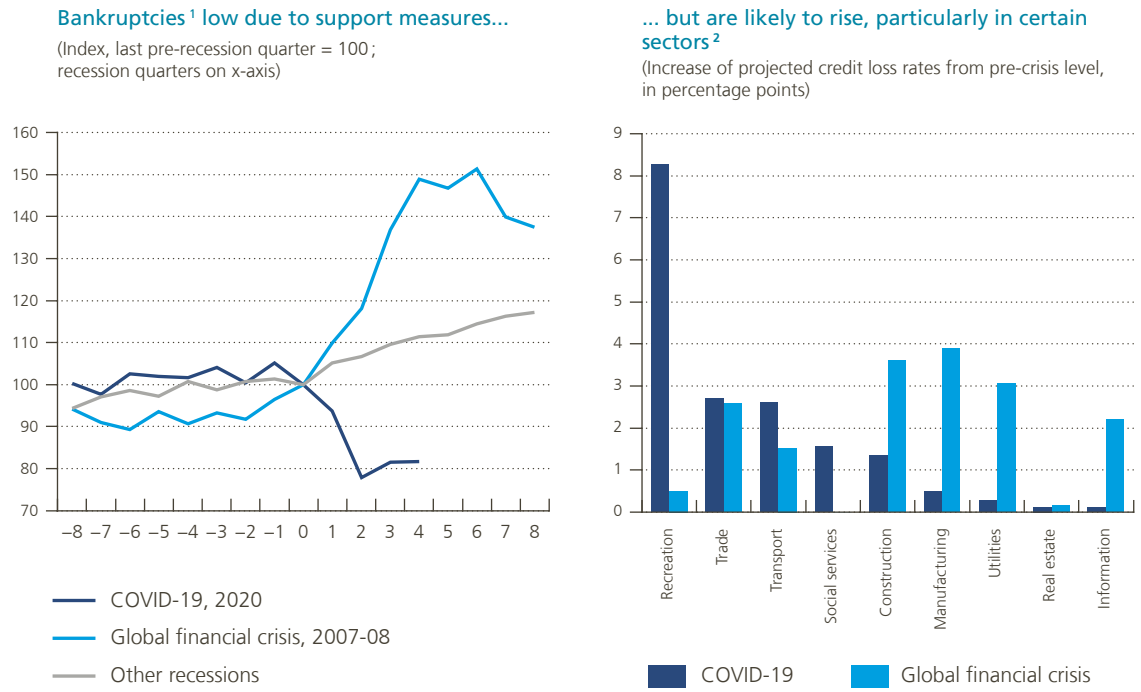
However, data show that insolvencies and bankruptcies have remained exceptionally low compared to earlier crises (see chart 9, left-hand panel), mainly due to the extremely generous support measures, such as debt moratoria, tax deferrals, direct grants and credit guarantees (IMF, 2021f), which helped to bridge liquidity needs in the short term. In several European countries, filing for bankruptcy was even temporarily suspended. These measures kept solvency problems at bay for most firms, particularly for the smaller ones without access to capital markets, and avoided the chain reaction on creditors and households that usually takes place during crises. Governments' support measures have absorbed much of the losses incurred by firms (and households) (ESRB, 2021). As an example, the NBB (2021) estimates that in Belgium approximately 85 % of the income losses across all sectors were borne by the government. Using balance sheet data for over 4 million European firms, Ebeke *et al.* (2021) find that, on aggregate, country-specific corporate relief measures may have saved 15 % of employment and up to a quarter of the value added of the corporate sector in Europe. Monetary policy has reacted forcefully too after the first market disturbances in March 2020 and managed to improve funding conditions. The relaxing of certain prudential measures for banks, in combination with public loan guarantees, has also made it easier for banks to continue to provide credit to the real economy.

As the recovery is gradually taking hold, the phasing out of these measures will likely lead to a rise in insolvencies for firms, particularly those in the hardest-hit sectors. A sectoral analysis by the BIS (Mojon *et al.*, 2021) projects credit loss rates for the G7-countries, Australia and China until the end of 2022. In a central scenario, taking government support measures into account, they estimate that credit losses will on average be around three times higher as before the crisis (2018-2019), with strongly heterogeneous results according to the sector and country studied (see chart 9, right-hand panel).

The OECD and IMF have also conducted analyses on the effects of the current crisis on corporate solvency. According to the OECD (Demmou *et al.*, 2021), between 30 and 36 % of firms would not be profitable enough to cover interest charges, again with strongly heterogeneous results according to the sector. Despite the positive effects reported by the IMF (Ebeke *et al.*, 2021) with regard to the implemented corporate relief measures, their analysis shows that the increase in solvency risks cannot be fully relieved. Even with the support policies implemented as planned, the share of insolvent firms could increase by 6 percentage points to 17 % in advanced economies and by 5 percentage points to 24 % in emerging economies. Focusing only on those companies that were solvent before the pandemic, simulation results still suggest that, despite all the policies implemented, the COVID-19 outbreak could make 7 % and 8 % of those firms insolvent in respectively advanced and emerging economies.

Chart 9

More solvency problems could lie ahead, particularly in certain sectors



Sources: BIS, IMF.

1 Based on data from 13 advanced economies with varying coverage during 1990Q1-2020Q3. Lines are averages across recession types. For the COVID-19 crisis, quarter 0 is 2019Q4 for all countries; for the global financial crisis, quarter 0 is country-specific peak of real GDP during 2007-2008; Other recessions are country-specific episodes of at least two consecutive quarters of negative growth during 1990-2006 and 2009-2019.

2 Based on data for G7 countries, China and Australia. Credit losses are defined as recognised impairments on bank and non-bank debt.

The above examples clearly show that challenges remain when the current support measures are phased out. The health of the corporate sector will crucially depend on the further development of the pandemic and the efficient targeting of support measures to those firms that really need it, while avoiding locking in resources in ultimately unviable firms ("zombie firms").

2.2.3 Currency risks

Solvency risks of companies can be amplified by other factors. One is the amount of foreign currency debt issued, particularly if the proceeds from debt are used to generate earnings and invest in domestic currency.

Currency risks linked to possible currency mismatches mainly seem to concentrate in specific regions and in the non-tradable sector, particularly in a few specific (net importing) sectors such as construction and retail (Abraham *et al.*; 2020). Firms in the tradable sector tend to have a natural hedge against currency risks on their debt as they are usually also gaining income in foreign currency.

In several emerging economies, firms in the non-tradable sector have issued large amounts of international corporate bonds (Chui *et al.*, 2016). Nevertheless, the largest growth in corporate bond financing in emerging economies occurred in local bond markets through domestic currency issuances, mainly driven by Chinese companies. Starting in 2008, the first year during which Chinese corporate bond issuance reached significant levels, the percentage of domestic currency denominated bonds reached 90 % in China. If they were excluded from the sample, the foreign currency share of bonds issued by emerging economies'

non-financial corporations would still hover around half of all outstanding bonds. In advanced economies, only around 20 % of corporate bond issuance was foreign currency denominated in 2018, a share that has been relatively stable over time.

These general developments do not rule out the possibility of currency risks building up in particular sectors or economies. In addition, some firms deliberately get involved in risky practices. In this regard, Acharya *et al.* (2015) discuss earlier evidence that non-financial corporations in Latin America have played the role of financial intermediaries, using the proceeds of international bond issuance to maintain cash or liquid assets when the conditions for carry trade are more attractive. They show that this behaviour is used by companies to circumvent capital controls when interest rate differentials are large. Also, Harasztosi and Katay (2020) demonstrate that carry trade and diversification strategies were relevant factors for Hungarian corporations' currency-of-denomination decisions.

Growth in foreign currency credit held up during the COVID-19 pandemic, standing in stark contrast to the large contractions observed during the GFC (BIS, 2021). Issuance of debt securities was the driver of dollar credit growth to all borrowers outside the US (+9 % year on year in 2020, similar to the average pace over the last 10 years), while bank loans in dollar stabilised. The difference in dollar credit growth between the GFC and the COVID-19 crisis is mainly explained by the differing evolution in bank lending in dollar as it contracted enormously during the GFC (–14 % year on year in 2009Q3 compared to 0.6 % in 2020). While the euro-denominated debt for non-residents was characterised by similar developments than observed in US dollar-denominated debt in 2020, bank loans in Japanese yen to borrowers outside of Japan continued to growth strongly (+5.6 % year on year), whereas the issuance of debt securities declined significantly (–5.3 % year on year).

2.2.4 Rollover and refinancing risks

Rollover risk arises when debt is about to mature and needs to be converted or rolled over into new loans or debt securities. The higher the overall financial leverage of a company, the more it becomes exposed to the risk that a share of its debt cannot be rolled over or refinanced, or only at a significantly higher cost. Companies are more vulnerable to rollover and refinancing risks if the maturities of their debts are shorter and, linking this risk to the previous section, if they have a larger share of foreign currency denominated debt.

In general, maturities of debt securities are shorter in emerging than in advanced economies as the term premia for companies in emerging economies are higher (linked to higher default and inflation risks). After the GFC, maturities of bond issuances in emerging economies declined, while the average maturity of outstanding debt from companies in advanced economies continued to hover around eight years. Nevertheless, the decline in maturities in emerging economies was mainly driven by China : while the Chinese average declined from six to three years between 2008 and 2018, it only came down from seven to six years in other emerging economies (Çelik *et al.*, 2019).

As a consequence, for emerging economy corporations, almost 50 % of the outstanding amount of bonds at the end of 2019 needed to be rolled over between 2020 and 2022. When taking all bond categories into account, the outstanding bonds that needed to be rolled over within the next three years came to a record share of 32 % of the total at the end of 2019 (Çelik *et al.*, 2020). Moreover, related to the decline in the quality of issued bonds, maturities of outstanding non-investment-grade bonds became particularly shorter in recent years, while those of investment grade bonds became longer. This situation clearly carries risks given the current situation and the perspective of a tightening of monetary policy once the recovery is firmly entrenched.

Despite the shortening of bond maturities, Abraham *et al.* (2020) point out that the compositional change from loan towards bond financing since the GFC could have had a positive effect on overall (loan plus bond) debt maturities, as bank loans usually have shorter maturities than bonds. The aggregate effect on debt maturities thus remains unclear and cannot be easily calculated as data on bank loan maturities are not publicly available across economies.

2.2.5 Risks to financial stability

The foregoing also entails risks for financial stability, as the interconnection between firms and between firms and banks or other investors is strong. The COVID-19 pandemic and its consequences are the first big test of the financial system's resilience after the GFC and the changes in financial regulation it brought about.

If some of the earlier-mentioned risks materialise and lead to losses for banks and other investors, the financial sector could be negatively affected, both through indirect and direct channels. Several of the policy actions taken in response to the pandemic are fortunately helping the financial system to cope with the shocks and to support confidence and continued lending. The Financial Stability Board has also issued principles to guide national responses to COVID-19 and avoid diverging policies that would distort the level playing field and lead to market fragmentation (FSB, 2020).

The risks to financial stability are nevertheless contingent on the further evolution of the crisis and the policy response. They could be exacerbated if some of the changes that are currently taking place in the economy are cemented as more structural developments. For example, the IMF (2021c) focuses on the large risks surrounding commercial real estate, in which large value reductions were recorded in 2020 that could become structural if tendencies to shop online and work from home turn out to be more permanent phenomena after the recovery takes hold.

2.2.6 Risk of corporate debt ending up as government debt

Another important risk is that corporate debt ends up on the government's balance sheets if loans for which the government has provided guarantees cannot be repaid. In certain countries, these risks are not negligible and the phasing out of support measures must be well monitored to prevent them from materialising.

3. The way forward

So how do we move forward from here? How can high debt ratios be brought down, or at least kept under control? As before, we first look at policy options for managing public debt before we dive into corporate debt.

3.1 Policies to keep public debt under control

Different policy options exist to reduce or, at the minimum, stabilise public debt ratios (see Reinhart *et al.*, 2015), but they vary significantly in terms of feasibility and desirability[1]. So-called "heterodox" policy actions – which include outright default or public debt restructuring, generating unexpected inflation, and financial repression – have often been relied on by emerging economies as well as advanced economies in the past, but in the current context they appear to be unrealistic and highly undesirable.

3.1.1 No room for "heterodox" policies

While it is true that, historically, most of today's advanced economies have known (several) episodes of default and/or debt restructuring, there have been no such episodes in advanced economies since the 1970s, with the exception of the Greek and Cypriot restructurings (Reinhart and Rogoff, 2009; Mitchener and Trebesch, 2021). In contrast to the precarious state of affairs in several lower-income economies, for which the G20 has elaborated

1 For a discussion of the different policy options with respect to Belgian public debt more specifically, see Cornille *et al.* (2021) in this issue of the Economic Review.

debt relief initiatives[1], the current public debt situation in advanced (and most major emerging economies) is not such that a forced debt restructuring is warranted: governments are still able to finance their high debt levels at low cost and the crowding out of the fiscal space for essential social and economic expenditures by debt service seems limited for now. Yet, there have been calls to cancel the euro area public debts held by the Eurosystem. As Boeckx and Debrun (2021) and Cornille *et al.* (2021) explain in detail, however, such operations would not only be illegal (under the EU Treaty's prohibition of debt monetisation) and politically infeasible, but would moreover fail to yield much extra budgetary headroom (as the cancellation of interest payments to the Eurosystem would be compensated by losses in central bank dividends to governments) and would be very risky (undermining the "risk-free" status of government liabilities and confidence in the euro). Also, a large write-off of privately held debt claims on major European sovereigns would be problematic, especially in the absence of clear procedures[2], and would undoubtedly cause a severe financial crisis, given the highly integrated nature of European economies and their interwoven banking systems.

Alternatively, governments might try to erode their (local currency denominated) debt by means of generating surprise inflation and/or financial repression, i.e. policies aimed at keeping nominal rates on public debt below the free market rate, be it through regulatory restrictions or official interventions. Examples of such repressive policies include explicit or indirect caps or ceilings on interest rates; the creation and maintenance of "captive" domestic investor bases for government debt through capital controls and high non-remunerated bank reserve requirements; and close connections between governments and banks, such as direct state ownership or extensive state management of banks and other financial institutions (Reinhart and Sbrancia, 2015). Policies like these, often coupled with toleration of high inflation, were intensively used by advanced economies to bring down public debt levels in the post-World War II, Bretton Woods era (roughly from 1945 to the early 1980s) and beyond that in several emerging economies. That notwithstanding, the techniques behind the creation of unexpected inflation and financial repression ultimately boil down to "fooling" or exploiting creditors/investors and have been shown to have an adverse impact on economic growth (Jafarov *et al.*, 2019). Recurrent use would severely harm the credibility of governments and central banks and could un-anchor inflation expectations. In any case, especially so in financially liberalised advanced economies, there now appears to be much more limited room for financial repression[3]. According to indices measuring the intensity of interest rate controls, financial repression has also receded in emerging economies but typically remains more prevalent there than in advanced economies (Jafarov *et al.*, 2019).

3.1.2 Towards a mix of more "orthodox" policies?

Given the problems with heterodox policies, it makes sense to look further into more "orthodox" policy options, which usually comprise enhancing growth and/or running primary budget surpluses.

Growing out of debt – i.e. reducing public debt-to-GDP ratios by raising the denominator – is obviously the least painful option on the menu. But, engineering significantly higher economic growth is far from straightforward, especially in countries where high public debt may already be weighing on growth (see section 2.1.1). The spectacular economic growth of advanced economies in the immediate aftermath of World War II, which

1 In response to rising debt sustainability concerns and the lack of fiscal space to effectively deal with the COVID-19 crisis in lower-income countries, in May 2020, the G20 launched the Debt Service Suspension Initiative (DSSI), offering eligible countries a temporary suspension of debt service to their official bilateral creditors. In November 2020, this was followed by the creation of the G20 Common Framework for Debt Treatments beyond the DSSI, which could deliver deeper debt restructuring for the same group of lower-income countries, on a case-by-case basis (see IMF, 2021g).

2 Since 2013, following the Greek debt restructuring, all newly issued euro area government securities with a maturity above one year must include standardised collective action clauses, contract provisions which allow a qualified majority of bondholders to bind the minority to the terms of any debt restructuring and which thereby reduce the risk that minority creditors block and disrupt the restructuring process. There have also been calls to introduce a statutory sovereign debt restructuring mechanism (SDRM) in the euro area, typically linked to crisis lending by the ESM (e.g. Andritzky *et al.*, 2019), but such proposals have been met with much resistance (e.g. Tabellini, 2017).

3 As Schnabel (2020) explains, the ECB's (negative) interest rate policies and asset purchase programmes do not constitute "financial repression". She demonstrates that there is no systematic relationship between government bond issuance and the amount of bonds purchased by the Eurosystem in secondary markets; that the ECB's actual and shadow policy rates have followed a path that is not far from a Taylor-rule-based reaction function with respect to output and prices; that inflation expectations have not been accelerating (which would typically be the case under fiscal dominance); and that the disciplinary function of financial markets on sovereign bond markets has not been lost.

together with financial repression and high inflation contributed to bringing public debt levels down, was bolstered by a number of special factors which later largely disappeared: the sheer depth of the output declines during the war, fast labour force growth due to the demobilisation and reintegration of troops, the diffusion of wartime inventions for civilian purposes, and the very high returns on investment in (destroyed) physical capital (Reinhart *et al.*, 2015). We did not observe any similar boost to growth after the GFC, partly due to private sector debt deleveraging. Likewise, it remains to be seen whether the recovery from the COVID-19 crisis will lead to much faster growth (beyond the very short term).

Building up large and persistent primary fiscal surpluses appears to be economically and politically difficult too. According to a historical overview by Eichengreen and Panizza (2016), episodes of such persistent surpluses are relatively rare and have mostly occurred under exceptional circumstances. One example is the experience of Belgium from 1995 to 2005, when the country ran primary surpluses averaging more than 5 % of GDP and brought down public debt from more than 130 % of GDP to about 95 %. The first years of this period correspond with the run-up to the deadline for meeting the Maastricht convergence criteria, which was important for Belgium as a founding member of the Economic and Monetary Union. The period was also preceded and accompanied by key institutional reforms with respect to fiscal devolution, independent budget forecasts, and the monitoring and coordination of fiscal policies between federal and regional government levels (IMF, 2003; Bisciari *et al.*, 2015). Even if it were politically feasible, at the current juncture, any radical switch to austerity could well prove self-defeating, as fiscal multipliers are deemed to be higher during recessions (Auerbach and Gorodnichenko, 2012); large sudden cutbacks in spending or tax rises would thus likely have severe consequences for economic growth and public debt ratios.

Arguably, the most feasible way forward for public debt is a combination of various policies. First of all, governments would do good to continue using targeted and time-restricted crisis support to limit the scarring effects of COVID-19 on human capital and viable firms. Next, where financing costs remain low and (at least some) fiscal space is still available, these can be exploited to enhance potential growth. The COVID-19 crisis and associated recovery plans (including the support provided in Europe by Next Generation EU) hold opportunities to strengthen commitment to investment (in digitalisation and in a transition towards a greener, more energy-efficient economy, for instance). If such investment is well-targeted and accompanied by structural reforms in product and labour markets, it could put the economy back on a higher growth path and contribute to an "organic" reduction in public debt ratios. However, well-performing fiscal policy does not only require boosting productive spending but, equally important, compressing unproductive outlays. In countries where there is no longer any fiscal space, (gradual) consolidation will be needed, once the economic recovery is underway, in order to eliminate the structural deficits inherited from pre-COVID-19 times. Finally, it is important that governments draw out a credible medium-term trajectory for fiscal policy[1]. Such a trajectory will raise confidence in governments' fiscal policy and may therefore create extra budgetary room.

3.2 Policies to keep corporate debt under control

To prevent the risks of high corporate debt from materialising, some consensus has emerged about a mix of policies to ensure that the current COVID-19 crisis does not lead to a strong increase in insolvencies, the consequences of which could trickle down to other firms, households, governments, banks and investors. Countries will need to slowly phase out support measures once the acute phase of the crisis has passed and improve their legal mechanisms to reduce the effects of debt overhang and prevent long-term economic scarring effects (Liu *et al.*, 2020; Demmou *et al.*, 2021; Ebeke *et al.*, 2021).

First of all, support measures for firms taken in response to the COVID-19 pandemic need to be state-contingent, targeted to the hardest-hit sectors, but also well-designed and flexible so that they can

1 See Bisciari *et al.* (2020) for a discussion of multi-year budgetary planning in Belgium and in the European context.

easily be phased out/adapted once the recovery takes hold. The goal of these support measures, such as moratoria, tax deferrals and subsidies, is to provide liquidity to firms in need to avoid solvency problems in the short run. Nevertheless, support should focus on firms that are in essence viable and only suffer from a short-term exogenous shock. It is important to try to avoid market distortions and locking in financial means in non-viable firms, as this would undermine aggregate productivity growth and inhibit the creative destruction process.

To reduce non-financial corporations' high leverage and restore the balance between equity and debt financing, equity financing (and hybrid instruments) needs to be promoted. Equity financing can be supported both at national and international level, for example by addressing regulatory bottlenecks to stimulate the development of capital markets (e.g. the Capital Markets Union in the EU). In the context of the COVID-19 crisis, many countries have taken initiatives to support (quasi-)equity financing for firms. Examples include the *prêts participatifs* in France, the Seed Capital scheme in the Netherlands, and new resources for Bayern Kapital in Germany. Several governments have also put more financial capacity into existing financial institutions that can boost corporate equity, such as national development banks. Moreover, as mentioned above, a reform of tax policies can help to restore the balance between equity and debt financing by firms, for example by introducing an allowance for corporate equity in countries where this does not yet exist.

Several actions are advocated to cope with the possible surge of firm defaults, insolvencies and non-performing loans as crisis support measures are phased out. It is important to consider these reforms early as insolvencies and bankruptcies are still low (see section 2.2.2), because some of them will take time to put in place. A reform of insolvency procedures is a good example, as it takes time to pass into law, while the new and more efficient structure should ideally be in place by the time the acute phase of the COVID-19 crisis has passed.

In this respect, the regulatory frameworks for debt restructuring may need to be adapted, in order to enable viable firms to remain in business after a quick and efficient restructuring process. Insolvency procedures may also need to be reformed to make a timely exit of non-viable firms possible, as well as to ensure that the system can cope with large volumes of cases and that the legislative barriers for restructuring and bankruptcy are lowered, particularly for SMEs and businesses without assets. Effective insolvency procedures and an early recognition of credit risk can also help to decrease lending to zombie firms (ECB, 2021). From experience with earlier crises, it appears that setting up hybrid and "out-of-court" procedures is best practice to minimise the time and cost of restructuring and insolvency procedures. Revision of other laws may be needed to support efficient out-of-court debt restructuring procedures, such as corporate governance rules on the responsibilities of managers in firms, and securities and tax laws (Laryea, 2010).

Once the support measures are wound down, the share of non-performing loans (NPLs) is likely to rise, as seen in the wake of earlier macroeconomic crises. However, it is hard to assess to what extent the share of NPLs would rise, as the current crisis is atypical in many respects: a common shock with heterogeneous impact, extremely generous fiscal support measures, and a high degree of uncertainty surrounding the economic consequences of the shock and the strength of the recovery. This high uncertainty also makes it necessary to design state-dependent policies (Kasinger *et al.*, 2021).

Previous crises have shown that it is important to foster proactive NPL management to contain the negative fallout from rising NPLs. In this context, it is essential that banks realistically assess current loan values in order to avoid any delayed recognition of losses and the continued financing of zombie firms (Laeven and Valencia, 2018). This goal can be achieved by effective asset quality reviews, stress tests and adequate accounting rules. Forbearance, other state aid and public bank capitalisation should be phased out as the recovery progresses, to provide the right incentives to banks to tackle their NPL problems. A secondary market for NPLs also has the potential to be an important component of NPL resolution (Kasinger *et al.*, 2021). Lastly, earlier crises have shown that asset management companies can be an effective way to maximise asset recovery for banks while supporting rehabilitation of viable corporations through debt restructuring (Laryea, 2010).

Last, but not least, it is important to closely monitor financial risks and take macroprudential measures to minimise them, and to do this in a targeted way to avoid general tightening with possible negative growth effects (IMF, 2021c).

Conclusions

In this article, we have presented the main trends in the public and non-financial corporate debt in advanced and major emerging economies, highlighted the disadvantages and risks associated with high debt, and discussed the way forward, i.e. the different policy options there are to reduce debt burdens or, at least, to keep them under control. The main takeaways can be summarised as follows:

Both public and corporate debt ratios are reaching historic highs in advanced and major emerging economies with the COVID-19 crisis exacerbating an already increasing trend. It is unlikely that these debt levels will come down significantly any time soon. The low interest rate environment has facilitated this debt surge, not least through a consequent search for yield by investors.

High public debt may weigh on growth and raise sustainability concerns, but no universal threshold appears to exist; much depends on the actual use of debt proceeds, the composition of the investor base, and public debt structure. Negative interest rate-growth differentials (r-g) provide some extra breathing room but are certainly no panacea. High corporate debt implies risks of low investment, productivity and growth; misallocation of resources; insolvency; zombification of firms; and financial instability.

Heterodox policy approaches to public debt reduction such as debt restructuring, the creation of surprise inflation, or financial repression appear to offer no viable way out. A combination of more orthodox policies is arguably more desirable and feasible. The optimal mix of targeted crisis support, investment to boost potential growth, and fiscal consolidation depends on countries' fiscal space and the pace of their recovery from the COVID-19 crisis. It needs to be accompanied by credible medium-term fiscal plans. To attenuate corporate debt problems, policy-makers should also consider a combination of tools, including flexible, state-contingent support measures in the acute phase of the crisis, reforms to corporate debt restructuring and insolvency procedures, and the promotion of equity financing.

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Wage differentiation in Belgium according to SILC data

Y. Saks

Introduction

Employees still represent over 85 %[1] of persons in work in Belgium. What is the trend in wages according to the harmonised European microeconomic data ?

Apart from the dominance of salaried workers in total employment, employees in Belgium are often paid according to a set pay scale. In addition to the impact of the level of education and skills, it is experience or the number of years spent working for the employer that determine the wage level.

With a centralised wage bargaining system and – for the private sector – differentiation primarily depending on the joint committees covering firms according to their main sphere of activity, wage dispersion is rather low in Belgium compared with other countries.

The article takes stock of the return on experience according to recent data. Did this return change in the light of technological progress, globalisation and the increased organisational scope for firms to manage their production, leading to fundamental changes in the world of work ? In line with normal practice in empirical research on wages, the findings are presented separately for men and women.

The database used in this paper is the Statistics on Income and Living Conditions (SILC)[2]. It is a survey designed to give an overview of the income distribution in Belgium and its Regions. For employees, it contains reliable information about their individual characteristics, their jobs and the gross wages. Furthermore, the SILC data provide some information about the family setting of the worker.

The article is structured as follows. After a brief introduction, section 1 provides more detail on the data, variables and methodology used. In section 2, we present our findings. The last section sets out the main conclusions of the analysis.

1 According to the Labour Force Survey, employed population aged 20-64 years, 2019.

2 We would like to thank Eurostat for providing the data used in this paper, under Contract RPP 161/2018-EU-SILC. The data were made available by Eurostat in November 2020. Any opinions, findings, and conclusions expressed in this material are those of the author(s) and do not necessarily reflect the views of Eurostat. The usual disclaimer applies.

1. Wage determinants and SILC data

1.1 The SILC data

The SILC survey assesses the income and living conditions of persons living in private households (excluding persons living in a community) for all European countries, including Belgium and its Regions. This annual survey focuses on both individuals and households.

In Belgium it concerns around 6 000 households. Here we use cross-sectional data from the 2019 survey. The reference period for income (including gross pay for employees) is a fixed 12-month period. For Belgium, it is the calendar year. In other words, wages here relate to the year 2018. The other data are collected at the time of polling.

In the SILC, gross pay comprises the wages paid according to the working arrangement/work specified by the contract plus payments for overtime, the variable remuneration element, holiday pay, Christmas bonuses and any other bonuses (such as profit sharing, performance bonuses, etc.). However, it excludes the reimbursement of expenses (travel, etc.) and redundancy pay or supplementary amounts paid by the employer on retirement. To sum up, this way of measuring gross pay in the SILC corresponds closely to the concept of remuneration under Belgian social law.

1.2 SILC data and the estimation of a Mincerian wage equation

While employees move up the career ladder mainly as a result of experience gained and changes to their jobs, the qualifications and skills relevant to the occupation have a decisive influence on the wage level.

In the SILC data there is no variable which directly measures monthly or hourly pay. We construct the hourly pay on the basis of annual remuneration, the number of months that the person has worked as an employee, and the number of hours specified in the contract of employment. Employees who have changed their working arrangements during the reference year are excluded.

According to the pioneering work by Mincer, the wage equation links wages to three groups of variables: those describing initial training, those describing experience (from entry to the labour market[1]) and finally, the other characteristics (characteristics of the worker, the employer and the job). It therefore provides an estimated return on qualifications and experience, all other things being equal.

To avoid heteroskedasticity problems, we use the logarithm of the wage for the estimate. The coefficients are easy to interpret in the log-linear specification: they measure the relative difference in relation to the reference individual's wage.

2. Econometric results and discussion

The model performs well since the variables used explain more than 45 % of the observed variation in gross wages.

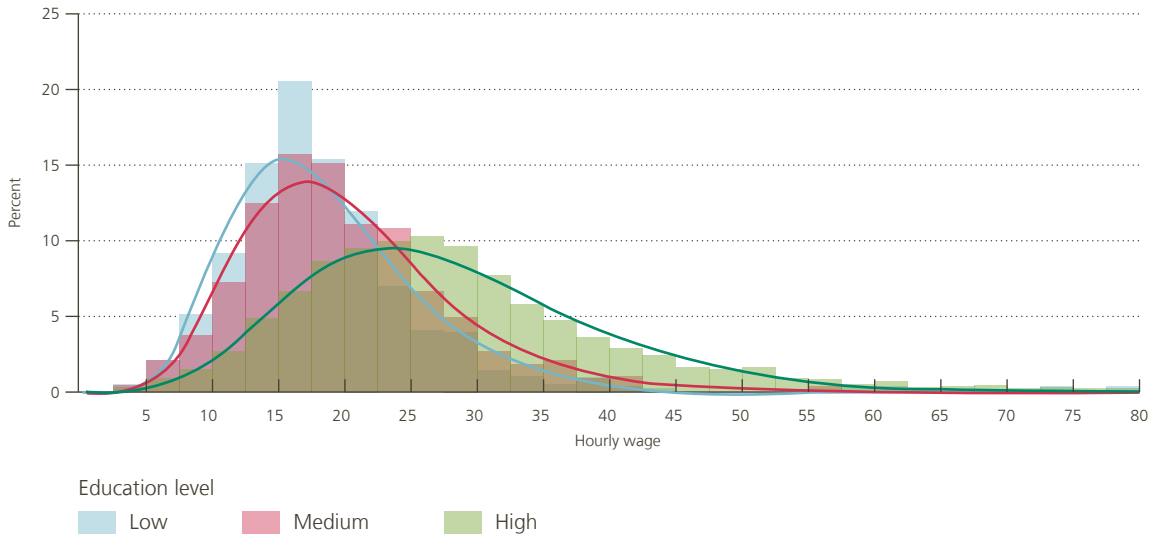
The return on a diploma is given by the parameter of the corresponding indicative variable (Table 1). All other things being equal, persons completing their secondary education gain 9 % compared to the group with only low level diplomas in the case of men and 6 % in the case of women, while for higher education the gain averages 28 % for men and 27 % for women. In regard to skills, a skilled trade will pay on average 5 % more

1 Experience is measured as the number of years in paid work. The length of service with the current employer is not available in SILC, but we can see whether there was a change of employer during the reference year.

Chart 1

Gross hourly wage distribution[1] by education level

(in € per hour worked, Belgium, 2018)



Source: Eurostat (SILC 2019, unweighted data).

1 For the purposes of this presentation, the hourly wage scale ends at 80.

than a basic trade[1] for a man and 19 % more for a woman, while in the case of a highly skilled job the gap is 26 % for men and 34 % for women compared to a job requiring no skills at all.

The returns on diplomas and skills are averages. Chart 1 presents the distribution of gross hourly wages by educational level. Wage dispersion is high for the remuneration of persons with a higher education diploma, whereas it is very low in the case of persons with a low level of education, the minimum wage constituting the lower bound. These differences in dispersion between the three classes of employees are statistically significant.

In Belgium, it is not the minimum wage set by the National Labour Board that is relevant, but the minimum wage under the various joint committees, because few employees actually receive the statutory minimum wage[2], even though almost all private sector employees are covered by the collective agreements. A rough estimate of the statutory minimum hourly wage for 2018 is € 10. There is no visible peak on the histogram around the statutory national minimum wage. According to Vandekerckhove *et al.*, sectoral minimum wages in 2015 were on average 19 % higher than the statutory national minimum wage.

There could be an upward bias in the estimated return on a diploma, particularly if there are unobserved characteristics which have a positive influence on both professional success and the decision to extend one's education (such as 'ability' for example). In that case, the additional pay obtained by gaining a diploma does not only measure the effect of education, since it is also partly remuneration for greater talent[3].

1 Examples include domestic help, labourers in industry or agriculture, refuse collectors, street traders or workers in fast food outlets. Occupational groups are based on the International Standard Classification of Occupations (ISCO), the latest version of which dates from 2008 and which was used in the surveys from 2011 onwards. This classification, produced by the International Labour Office, is revised periodically according to the content in terms of occupational tasks.

2 According to recent estimates of Vandekerckhove *et al.*, the share of employees working for the statutory national minimum wage in Belgium is around 2-3 %, while older estimates by Kampelmann and Rycx (2012) were about 6 %. The complex nature of the statutory national minimum wage in Belgium explains the discrepancies in the estimates. For comparison, the share of employees paid the minimum wage in France was around 13 %.

3 In other words, the return on education estimated here is most likely an upper bound.

Table 1

Wage equation by gender

(gross hourly wage in logs, Belgium, 2018)

Variable	Male			Female		
	Parameter Estimate	Standard Error	Pr > |t|	Parameter Estimate	Standard Error	Pr > |t|
Intercept [1]	2.5112	0.0533	<.0001	2.3352	0.0493	<.0001
Experience	0.0275	0.0025	<.0001	0.0240	0.0024	<.0001
Experience squared	–0.0004	0.0001	<.0001	–0.0003	0.0001	<.0001
Recently changed job	–0.1233	0.0293	<.0001	0.0333	0.0303	0.2707
Medium educated	0.0859	0.0239	0.0003	0.0565	0.0270	0.0366
Highly educated	0.2817	0.0275	<.0001	0.2578	0.0297	<.0001
Cohabitant	0.0296	0.0170	0.0810	–0.0016	0.0155	0.9160
Non-EU nationality	–0.1787	0.0387	<.0001	–0.0919	0.0458	0.0449
Wallonia	–0.0404	0.0167	0.0154	0.0123	0.0159	0.4415
Brussels	0.0060	0.0221	0.7855	0.0445	0.0222	0.0457
Skill level missing	0.2044	0.0788	0.0096	0.3019	0.2434	0.2150
Medium skilled	0.0508	0.0363	0.1613	0.1916	0.0262	<.0001
Highly skilled	0.2584	0.0386	<.0001	0.3400	0.0289	<.0001
Temporary contract	–0.1409	0.0310	<.0001	–0.1847	0.0260	<.0001
Part time	–0.0487	0.0239	0.0420	0.0025	0.0152	0.8690
Agriculture	–0.0672	0.1283	0.6006	–0.2282	0.1735	0.1884
Construction	–0.1618	0.0309	<.0001	–0.0782	0.0684	0.2532
Trade	–0.1218	0.0275	<.0001	–0.0720	0.0353	0.0419
Transportation	–0.1496	0.0308	<.0001	–0.0247	0.0544	0.6491
Accommodation and food	–0.2125	0.0533	<.0001	–0.1489	0.0550	0.0069
Information and communication	–0.0819	0.0358	0.0221	–0.0287	0.0532	0.5900
Financial services	0.0975	0.0407	0.0166	0.0943	0.0468	0.0442
Professional, scientific and technical activities	–0.1784	0.0315	<.0001	–0.0507	0.0342	0.1382
Administration	–0.0853	0.0267	0.0014	–0.0083	0.0328	0.7997
Education	–0.1321	0.0313	<.0001	–0.0479	0.0312	0.1250
Health and social work	–0.1746	0.0341	<.0001	–0.0691	0.0294	0.0188
Arts and other services	–0.1367	0.0400	0.0006	–0.0850	0.0406	0.0365
Employer's size [2] 11-20	0.0320	0.0323	0.3225	0.0339	0.0302	0.2614
Employer's size 21-49	0.0656	0.0296	0.0266	0.0520	0.0265	0.0501
Employer's size 50 or more	0.1768	0.0250	<.0001	0.1279	0.0224	<.0001

Source: Eurostat (SILC 2019, unweighted data).

1 Wage (in log) of a person who has not recently changed employer, with a low level of education, living alone, a national of an EU country, resident in Flanders, performing a low-skilled job under a full-time, permanent contract in industry, for an employer with no more than 10 employees.

2 This variable refers to the size of the establishment. An establishment is an enterprise or part thereof (e.g. a workshop, factory, warehouse, office, etc.) situated in a geographically identified place. However, the work location is not available in our version of the data.

Wages reward experience. In theory, there is general experience which can be transferred from one job or employer to another, and experience which is specific to a particular job or employer and is not necessarily useful outside of that context. Employees may thus face a loss of wages if they have to change jobs, because their specific experience is not valued ("displaced worker effect").

In the SILC survey, experience is measured by the number of years in paid employment since entering the labour market. We have no data on tenure, i.e. the number of years in service with the same employer or in the same branch of activity ("sector tenure"). On the other hand, the persons polled have to state whether they have changed their job in the past year. We therefore have a way of identifying persons with brief tenure. The reason for the change of job (end of temporary contract, job loss, change of employer, etc.) is not specified.

According to the specification used, wages rise by around 2.5 % per year of experience up to a maximum. The return on experience is similar for men and women. Over the period 2012-2018, there were no striking changes : on average, occupational experience is rewarded in 2018 wages to the same degree as in 2012 wages. For persons who have had to change their job, there is a negative effect of around 5 % to 10 %. The small positive effect of a change of job for women, estimated with 2018 wages, is not statistically different from zero (see table in the annex for estimates per year).

On the basis of the same data for neighbouring countries, the return on experience is similar to that estimated for Belgium. The only exception is France, with a lower return on experience of around 1.6 % per year, compared to 2.5 % in the other three countries. The effect linked to a change of employer is similar in Belgium and Germany, but is not significant in France or the Netherlands.

Cohabiting seems to have a small positive effect on men's wages, whereas that effect is not significant for women. Having a non-European nationality is linked to lower gross pay in Belgium, reducing wages by around 17 % for men and 10 % for women. Nevertheless, the employment gap between nationals and non-EU citizens in Belgium is still the largest among all European countries, with a difference of more than 28 points in 2019 for the 20-64 age group.

Differences in remuneration unconnected with the employee's characteristics are also considerable. The employer's size and sector of activity are the factors which emerge most clearly from the available data.

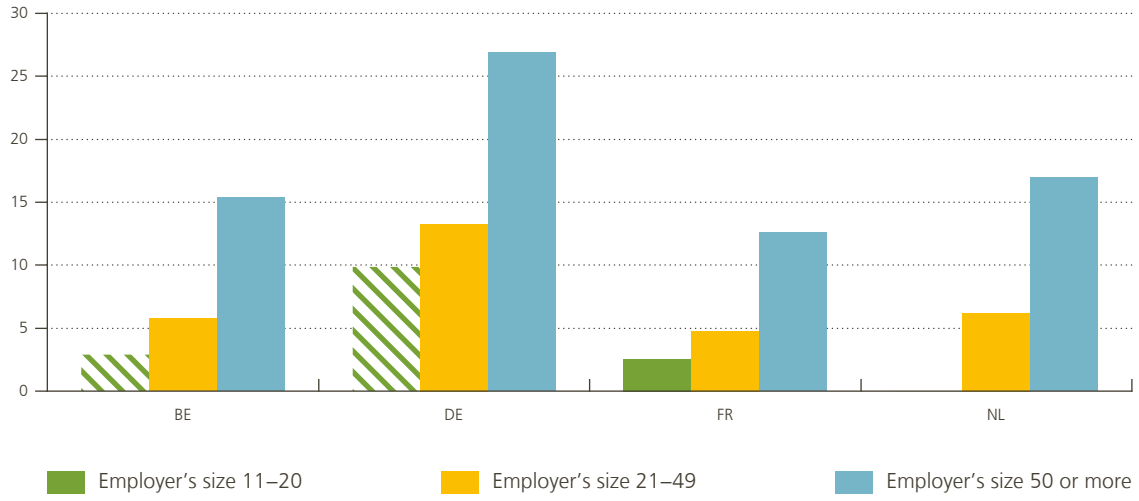
The size of the employer is an important factor in the differentiation in workers' wages. The fact that large employers pay higher wages than small employers has long been recognised but there is less agreement on the rationale behind this empirical fact. For a survey of possible explanations, see Lallemand and Rycx (2007). In all countries, including Belgium, the social dialogue institutions have more power the larger the workforce. In large companies the staff are, on average, more likely to belong to a union. However, these institutional differences or variations in the rate of unionisation do not account for the effect of the firm's size (for US, Freeman, 1980). That is particularly true in Belgium, where collective agreements are automatically extended to all firms that come under a particular joint committee. More fundamentally, the largest firms are often also the most productive, owing to economies of scale and/or capital intensity, and part of the resulting value is reflected in remuneration. Large firms have more resources to spend on investment, including investment in their staff. Finally, it is probably more difficult to monitor the efforts of workers in large organisations as opposed to small and medium-sized firms. It may therefore make sense for firms to select their employees and ensure their level of effort by paying them more, rather than by setting up an expensive monitoring system (Ferrer and Lluis, 2008). The idea is that employees have more to lose if they do not make a sufficient effort. However, the degree of information asymmetry depends not only on the organisation's size but also on the nature of the business, the sector, etc.

According to the SILC data for Belgium, this size effect is statistically significant once the firm has 20 or more employees. The magnitude of the difference is also linked to size, since it is around 15 % for establishments with 50 or more workers, compared to 6 % for those with between 20 and 49 workers. These orders of magnitude

Chart 2

The employer-size wage premium[1] in Belgium and neighbouring countries

(in % for employers with fewer than 10 employees, 2018)



Source: Eurostat (SILC 2019, unweighted data).

1 The employer-size wage premiums were computed on the SILC data using the same specification for the four countries. Regional dummies were not included in that specification. Both male and female employees are taken into account. In the chart, a pattern means that the effect is not statistically significant.

are similar in neighbouring countries, with wider variations in Germany. These findings could be compatible with efficiency wage theories, but it could also be that larger firms offer a broader range of duties and hence more scope for advancement.

There are also wide variations in pay between branches of activity. The groupings in the SILC data are not detailed and refer here to industry in the broad sense, i.e. both manufacturing and undertakings in the sector comprising energy, water and waste management, etc. These are often large, highly capital-intensive undertakings. Compared to this group, only the financial sector records higher remuneration. At the other end of the spectrum, accommodation and food is the branch with the lowest hourly wages, followed by the construction sector.

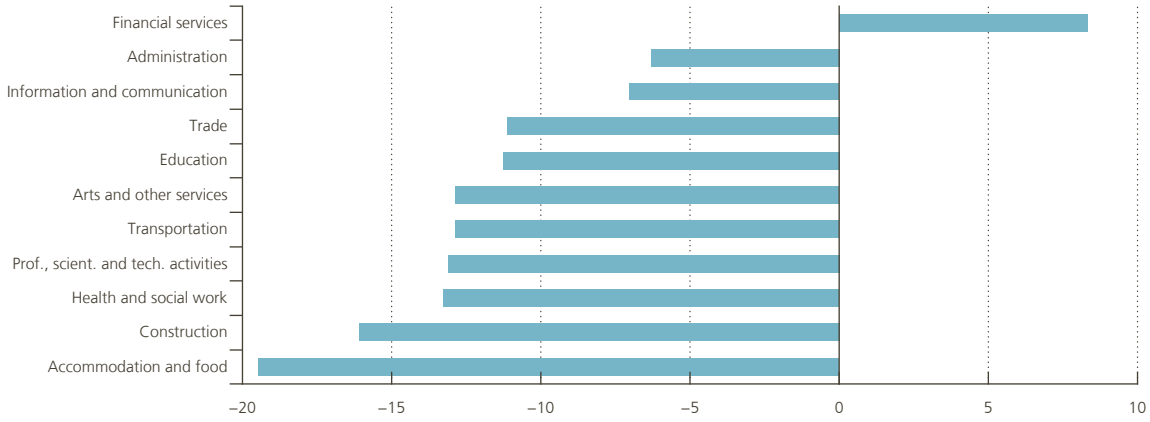
Finance and energy are both highly regulated sectors. Adjusting the product market regulations to increase competition within these branches could reduce the disparities. Organisational changes obliging all firms to refocus on their core business and use external suppliers for ancillary activities also affect pay differentials between branches. Depending on its sphere of activity, a firm may make greater use of agency staff or outsourcing to other firms or self-employed operators, and that alters the cost structure and reduces the weight of the wage bill.

The type of contract also depends on the nature of the activity. While permanent contracts remain the norm in Belgium, with open-ended contracts representing over 90 % of the total in 2019, the share of temporary contracts has risen slightly in recent years. The impact on hourly wages of a fixed-term contract is still significantly negative, and – even after controlling for other factors – amounts to around 15 % (depending on gender in 2019: 14 % for men and 18 % for women). In neighbouring countries and across Europe, there is an evident negative effect of between 10 % and 30 % depending on the country (Dias da Silva and Turrini, 2015). There are various theoretical explanations for this. First, it illustrates the fact that employment protection is more applicable

Chart 3

Industry wage differentials[1] are still sizeable after controlling for composition effects

(in % for manufacturing and utilities, 2018)



Source: Eurostat (SILC 2019, unweighted data).

1 Industry-specific premiums are estimated with a sample comprising both male and female employees.

to permanent contracts, reducing the employer's bargaining power in relation to employees with permanent contracts. Those employees are therefore both better protected and better paid. Also, it may be linked to information asymmetry at the time of recruitment. The quality of the match is an "experience-good", so that temporary contracts are often used in that context, which is why most of them apply to young employees. Finally, some unobserved characteristics could vary between employees with permanent contracts and other workers. In the 20-64 age group, 8.4 % of employees in Belgium have temporary contracts, compared to 9.3 % in Germany, 13.3 % in France and 13.6 % in the Netherlands.

Part-time work incurs only a small penalty in Belgium. This negative sign is due entirely to male employees. According to comparable specifications for neighbouring countries, part-time work is associated with a considerably higher penalty in Germany and the Netherlands (mini-jobs, etc.).

On the basis of 2018 gross wages and the specification used, there is a significant negative effect for male employees resident in Wallonia compared to Brussels or Flanders. The same exercise conducted for previous years showed no significant differences between Wallonia and Flanders. There is a small positive effect for Brussels, but the difference is no longer statistically significant from 2016 onwards. The positive effect for Brussels is sometimes explained by agglomeration affects, namely the presence and interaction of highly skilled employees, a dense network of activities and undertakings creating spillovers that boost the productivity of firms located in that region.

3. Concluding remarks

Wages in Belgium are largely determined by diploma levels, occupational skills and experience. For a representative sample of employees aged between 20 and 64 years, the average nominal increase in gross wages is 2.5 % per year of experience. Comparison with earlier comparable data shows that this return on experience is undiminished. It is similar to the figure estimated for Germany and the Netherlands, whereas the reward for

experience is slightly lower in French wages. In Belgium, according to our estimates, male employees who have changed their job (for whatever reason) generally record a reduction in wages, which could imply that specific experience, is not necessarily useful to their new employer.

Employees on permanent contracts still receive higher wages with respect to temporary workers, even after controlling for experience. Fixed-term contracts are in fact more likely to apply to young employees with limited work experience. This discrepancy between the types of contract could also indicate labour market segmentation, with insiders both better protected and better paid, while other employees are often stuck in temporary contracts. However, the pay gap of around 15 % between these types of contract is similar to the figure in neighbouring countries, whereas the percentage of temporary contracts is higher than in Belgium.

Although Belgium is a highly decentralised state, the wage setting process and social security are organized at the federal level. Since the 6th State Reform (2014), the Regions have had extensive powers relating to active labour market policies and targeted labour cost reduction measures. According to the 2019 SILC data, there are only very minor differences in average hourly rates between the Regions, with wages in Wallonia slightly lower than in Flanders, and wages in Brussels not significantly higher. Ideally, one would like to control in the wage equation for both the Region of residence and the work location.

An interesting avenue for future work would involve including in the wage equation productivity measures at the firm- or sector-level to test whether this leads to a reduction in the impact of the branch of activity, employer's size or type of contract effects. A better understanding of the link between wages and productivity could promote the reallocation of workers without creating excessive pay differentials between firms.

Annex

Wage equation: estimation results by income year

(gross hourly wage in logs, Belgium)

	2012	2013	2014	2015	2016	2017	2018
Intercept [1]	2.365	2.403	2.387	2.407	2.464	2.508	2.460
Experience	0.023	0.022	0.024	0.022	0.025	0.024	0.026
Experience squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Recently changed job	–0.016	0.020	–0.022	–0.094	–0.058	–0.061	–0.051
Female	–0.089	–0.073	–0.078	–0.074	–0.082	–0.088	–0.073
Medium educated	0.059	0.082	0.083	0.115	0.062	0.062	0.081
Highly educated	0.246	0.257	0.240	0.286	0.236	0.258	0.278
Cohabitant	0.031	0.036	0.018	0.009	0.005	0.025	0.016
Non-EU nationality	–0.063	–0.070	–0.044	–0.039	–0.023	–0.094	–0.139
Wallonia	–0.004	–0.008	–0.012	–0.007	–0.014	–0.003	–0.013
Brussels	0.034	0.058	0.029	0.055	–0.008	0.017	0.021
Skill level missing	0.212	0.250	0.194	0.166	0.082	0.157	0.262
Medium skilled	0.126	0.112	0.100	0.085	0.087	0.098	0.129
Highly skilled	0.285	0.261	0.274	0.250	0.248	0.219	0.310
Temporary contract	–0.084	–0.135	–0.140	–0.100	–0.123	–0.119	–0.164
Part time	0.041	0.011	0.010	0.035	0.013	0.013	–0.015
Agriculture	–0.199	–0.031	–0.081	–0.101	–0.056	–0.020	–0.111
Construction	–0.080	–0.105	–0.089	–0.060	–0.112	–0.116	–0.161
Trade	–0.083	–0.079	–0.071	–0.061	–0.088	–0.074	–0.111
Transportation	–0.042	–0.015	–0.083	–0.034	–0.069	–0.040	–0.129
Accommodation and food	–0.022	–0.121	–0.159	–0.093	–0.083	–0.118	–0.195
Information and communication	–0.074	–0.023	–0.032	–0.029	–0.058	–0.048	–0.070
Financial services	0.132	0.111	0.085	0.121	0.107	0.071	0.083
Professional, scientific and technical activities	–0.105	–0.064	–0.040	–0.123	–0.070	–0.100	–0.131
Administration	–0.056	–0.033	–0.052	–0.057	–0.043	–0.057	–0.063
Education	–0.060	–0.061	–0.040	–0.094	–0.089	–0.088	–0.113
Health and social work	–0.099	–0.075	–0.090	–0.105	–0.103	–0.089	–0.133
Arts and other services	–0.011	0.105	0.092	0.053	0.100	0.009	–0.128
Employer's size [2] 11-20	0.048	0.008	0.026	0.020	0.055	0.011	0.029
Employer's size 21-49	0.077	0.052	0.061	0.074	0.067	0.039	0.058
Employer's size 50 or more	0.145	0.114	0.122	0.139	0.152	0.110	0.152

Source: Eurostat (SILC 2019, unweighted data).

1 Wage (in log) of a person who has not recently changed their employer, with a low level of education, living alone, a national of an EU country, resident in Flanders, performing a low-skilled job under a full-time permanent contract, in industry, for an employer with no more than 10 employees.

2 This variable refers to the size of the establishment. An establishment is an enterprise or part thereof (e.g. a workshop, factory, warehouse, office, etc.) situated in a geographically identified place. However, the work location is not available in our version of the data.

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Belgian corporate sector liquidity and solvency in the COVID-19 crisis: a post-first-wave assessment

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Introduction

The coronavirus pandemic has led to a sharp fall in economic activity in Belgium. Many businesses have been forced to suspend (or severely downscale) their activities due to public health measures, supply chain disruptions, or the slump in demand for their products and services. Despite the fall in turnover, financial commitments (e.g. with respect to suppliers, employees, tax authorities, etc.) largely remain, depleting firms' liquidity buffers. Moreover, the accumulation of losses and growing indebtedness risk turning liquidity stress into a solvency problem. Due to the exceptional and unanticipated nature of the shock, no firm is immune to these concerns. Even firms that were profitable and had a solid financial structure prior to the pandemic are at risk of spiralling into bankruptcy.

Against the backdrop of a looming liquidity and solvency crisis, the Belgian Government set up the Economic Risk Management Group (ERMG). Its purpose was to document the impact of the COVID-19 crisis on economic activity. In the context of that mandate, the ERMG launched a survey which, *inter alia*, probes into firms' liquidity and solvency concerns. The survey responses were non-trivial: near the end of March 2020, half of the surveyed firms flagged an increased level of liquidity stress, with one in every ten indicating a higher risk of bankruptcy (ERMG, 2020a). In a follow-up survey in April 2020, one out of three firms in heavily affected sectors claimed insolvency to be very likely (ERMG, 2020b).

With a view to gaining a better understanding of the economic magnitude of these risks, the NBB has developed – in parallel with many other central banks and international policy institutions – an extensive monitoring framework to appraise the liquidity and the solvency concerns of Belgian non-financial corporations. The purpose of this framework is threefold. First, to quantify the pockets of liquidity and solvency risk in the real economy. Second, to provide relevant indicators to the public authorities in their efforts in designing and calibrating possible support measures (and conducting an *ex-post* policy assessment). Third, to monitor the implications for financial sector stability.

While the NBB is continuously updating and extending this framework, the purpose of this article is to provide an intermediate summary of the analyses conducted so far. As the framework requires input from an extensive

1 The authors are grateful for the valuable input and suggestions made by Saif Ben Hadj, Luc Dresse, Pelin Ilbas, Ilia Samarin, Thomas Schepens, Ruben Schoonackers, Stefan Van Parys, Pierre Wunsch and Economic Risk Management Group participants, as well as for the fruitful discussion of preliminary versions of this study.

set of granular data sources, updates follow in tandem with their availability. So, unless stated otherwise, the results presented in this article run up to September 2020, i.e. a few weeks before the start of the second wave of the pandemic. September presents itself as an appealing moment in time to take stock of the "as-is" situation in between waves. It enables us to document the destructive nature of the first wave, as well as to assess the situation at the onset of the second wave.

This article is structured as follows. In the first section, we present a high-level narrative of the impact of the COVID-19 crisis on firms' business operations. To that end, we leverage VAT returns which document monthly firm-level data on sales, procurement of intermediate goods and services, as well as acquisitions of investment goods. We highlight an important mismatch between revenue and cost dynamics as firms fail to downscale the latter in the face of declining revenues. This imbalance puts considerable pressure on firm liquidity and profitability in the short and medium run. In that context, we proceed with a quantitative assessment of the liquidity problems faced by firms. We first delineate the key features of the liquidity estimation framework and elaborate briefly on the data sources underlying the estimation. Based on a sample of around 400 000 non-financial corporations, we summarise the heterogeneous impact of the COVID-19 crisis on the cash position of Belgian firms in comparison to a business-as-usual counterfactual.

In the face of the heightened liquidity risk, a wide range of crisis measures were taken by public authorities in order to support firms' cash positions. Aside from accommodative monetary policy measures taken by central banks, other interventions include outright transfers, tax exemptions or deferrals from the various levels of government, as well as debt moratoria and an extension of State-guaranteed loans from the banking sector. In section 2, we investigate the extent to which (a sub-set of) policy interventions attenuated cash shortfalls of firms and assess the size of the remaining liquidity deficit. In contrast to the global financial crisis where a fragile banking system had been a significant catalyst of the crisis, we show that the banking sector has contributed to some extent to cushioning the impact of the current crisis through providing liquidity to a sub-set of firms.

Finally, as liquidity support to businesses is often provided through debt, it leads to increased leverage and default risk, leaving firms vulnerable with little room to invest and to grow. This predicament places solvency concerns at the top of the policy agenda. Therefore, section 3 investigates solvency risk arising from the initial (liquidity) impact of the crisis and examines the implications for the riskiness of banks' credit portfolios. We further show in this section that, while banks provided liquidity to firms during the first months of the pandemic, they seem to have taken little risk in the process.

The final section concludes and provides a set of policy implications. Relevant technical details underlying the framework are included in Annex A. The data used in the calibration/estimation exercises are detailed in Annex B. Annex C gauges the impact of the most important modelling assumptions.

1. The COVID-19 crisis and its impact on firm liquidity

The economic shock caused by the COVID-19 pandemic is unprecedented, both in its complexity and severity. Government-directed lockdowns in conjunction with the fear of falling ill not only caused disruptions in production, but also led to the largest collapse in demand for firms' output since WWII. In the first sub-section, we shed light on the impact of the COVID-19 crisis on the Belgian economy. Next, we take stock of the financial situation of firms prior to the pandemic and their operational response to the shock. Finally, we quantify the aggregate level of liquidity stress that ensued and highlight various pockets of liquidity risk in the Belgian economy[1].

1 Throughout this article, firms refer exclusively to non-financial corporations.

1.1 Impact of the COVID-19 crisis on firm operations

In March 2020, the rising number of infections prompted the Belgian authorities to take several measures to contain the COVID-19 outbreak and prevent a saturation of the health care system. Like in many other countries, a lockdown was put into effect, which involved an immediate closure of bars, restaurants, as well as non-essential retail stores and consumer services. At the same time, domestic and international travel was banned, and teleworking made compulsory for all businesses, except for activities requiring staff to be present on-site. Schools and higher education institutes also had to close, while physical social interactions were restricted to household bubbles. These containment measures were kept in place until early May and were gradually lifted for most sectors. Under stringent hygiene conditions, restaurants and bars were allowed to reopen in June. Some activities that involved close social contacts, such as cultural, recreational and sports events remained prohibited, unless certain severe capacity constraints were met.

While they were undoubtedly effective at curbing the pandemic and limiting its consequences in terms of public health, the containment measures brought about an economic shock of unprecedented magnitude. Belgian GDP dropped by 13.9 % in the second quarter of 2020, compared to the corresponding period of 2019. According to the firm-level VAT return data illustrated in chart 1, the decline in economic activity was the most severe in April, when the median shock to firms' turnover amounted to –32 % on a year-on-year basis. However, the shock was not evenly distributed across sectors : those most affected by the lockdown recorded the steepest sales decline [1]. For establishments serving food and beverages, for instance, the median decline in turnover was 94 % compared to April 2019. The drop was also significant for firms active in the cultural sectors (–86 %), sport and recreation (–94 %), as well as for hairdressers and beauty and wellness centres (87 %). The biggest impact was felt by accommodation businesses (–96 %), as travel bans were imposed by other countries as well. Economic activity began to recover in June, thanks to the easing of the lockdown. While sales seemed to return to their pre-crisis levels in many sectors, a significant number of businesses were still running below capacity as the authorities maintained, and even reinforced, certain health and safety measures related to social interactions during the summer. These measures have clearly hindered a full recovery in the cultural and recreative sectors.

Overall, the economic activity shock has been broad-based within the most impacted industries. Chart 1 illustrates that, for these industries, the first and the third quartiles of the sales shocks moved in conjunction with the median value. For some other sectors, however, the extent of the shock was more heterogeneous across firms. This was, for example, the case in the construction sector and among retail businesses selling non-food products. As far as the latter is concerned, this is related to the fact that not all the businesses included in that sector were affected to the same extent by the containment measures (e.g. essential business – such as pharmacies, petrol stations, newspaper shops – were allowed to remain open during the lockdown) while others benefited from a change in consumption patterns (e.g. higher demand for teleworking equipment, gardening tools, bicycles and/or substitution towards firms with online shopping solutions).

1 Annex D summarises the NACE codes, as well as the number of entities contained within the sector classification.

Chart 1

Impact of the COVID-19 crisis on firms' monthly sales in a selection of sectors

(Quartiles of the percentage changes in 2020 turnover compared to the corresponding month in 2019[1])

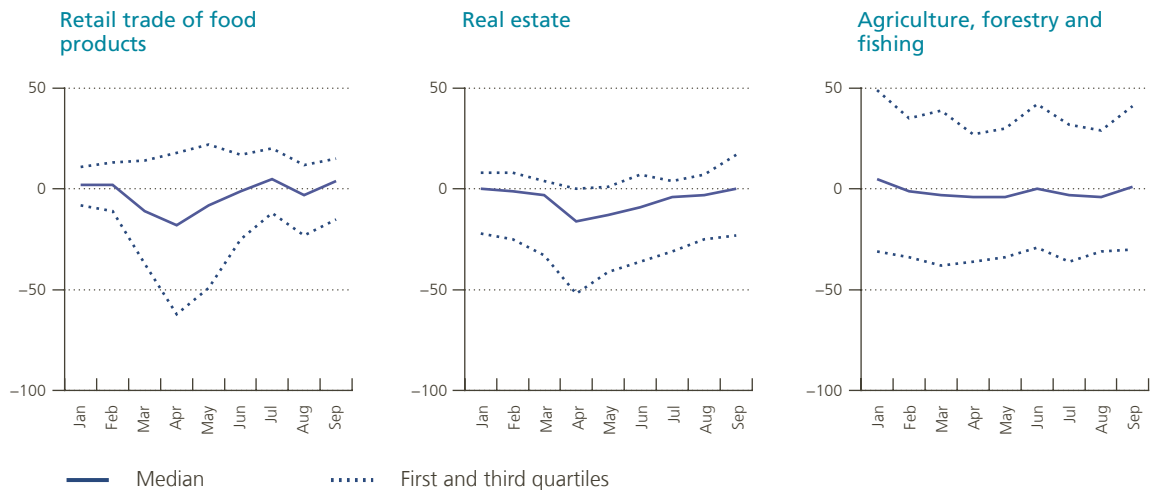
Sources: Federal Public Service Finance, NBB.

1 Series calculated for the population of firms filing monthly VAT returns.

Chart 1 (continued)

Impact of the COVID-19 crisis on firms' monthly sales in a selection of sectors

(Quartiles of the percentage changes in 2020 turnover compared to the corresponding month in 2019[1])



Sources: Federal Public Service Finance, NBB.

1 Series calculated for the population of firms filing monthly VAT returns.

1.2 Pre-pandemic liquidity position of firms

The heterogeneity in the magnitude and persistence of the shock to economic activity, both across and within sectors, also leads to a pattern in which some businesses may find themselves running out of cash while others are not. But there are at least two other factors that determine whether firms might, at some point, experience a cash shortage, preventing them from meeting regular payments to their suppliers and their employees. These two factors are a firm's liquidity buffer prior to the shock and its capacity to downscale costs in the face of a decline in sales.

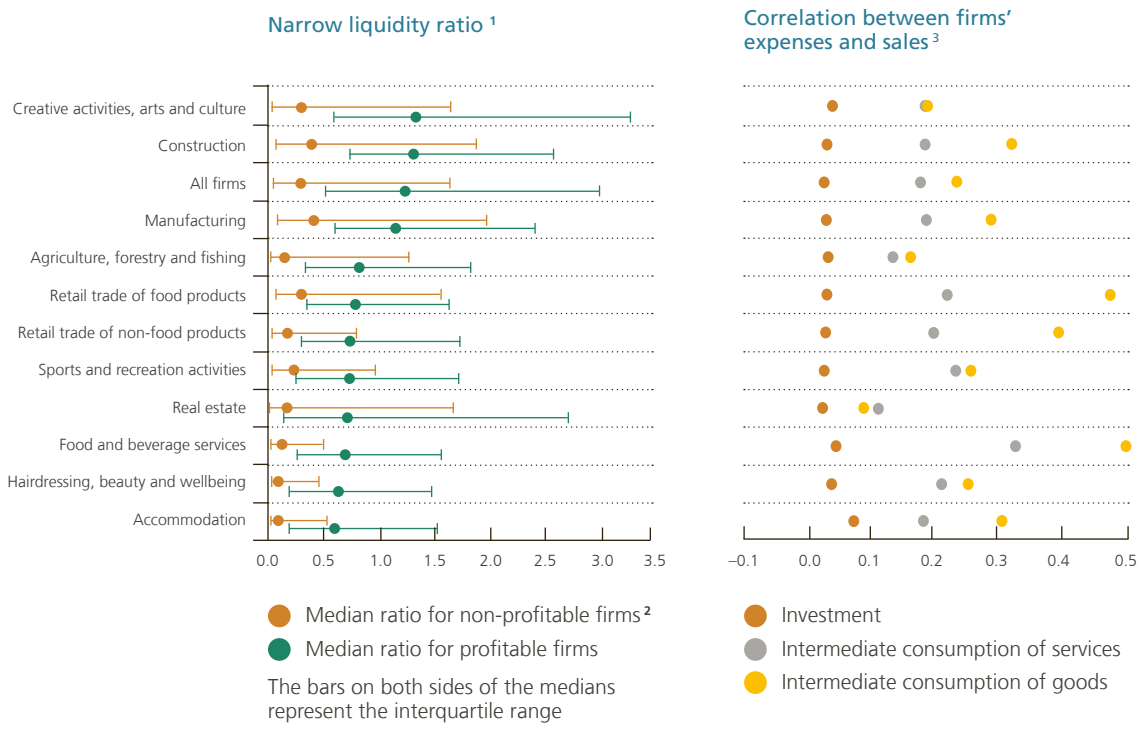
We first provide more insight into the first factor, i.e. the liquidity buffer built up before the shock, and how this buffer compares to companies' short-term liabilities. As in chart 1, there is a strong heterogeneity across firms, even within sectors. This is illustrated in the left panel of chart 2, which documents the interquartile ranges of the narrow liquidity ratio, i.e. the ratio of firms' most liquid assets to their short-term liabilities, calculated at the sector level. Strikingly, a relatively large fraction of firms exhibits a liquidity ratio below one, meaning that their short-term debt exceeded their liquidities at the closure of their last annual accounts. While this should not put them at risk in normal times (that is, when cash inflows from operating activities are usually sufficient for a firm to meet its short-term liabilities), it can become a major concern in the event of a sudden halt of these inflows, which is exactly what happened after the announcement of the lockdown.

The data reported in chart 2 additionally reveal that non-profitable firms are more likely to be affected by discontinued operations. Intuitively, profitable firms are generally more resilient as their pre-pandemic operating surpluses and retained earnings have enabled them to accumulate cash reserves. Nonetheless, even the liquid assets held by perfectly viable firms might prove insufficient to face the consequences of a prolonged period of inactivity. Pre-pandemic liquidity positions are relatively weak in those sectors that were most affected by the containment measures, even among profitable businesses. One very plausible explanation for this lies in the limited working capital requirements of the firms active in these sectors, i.e. the cash reserves they need for remunerating their staff and settling their suppliers' invoices, among other things, before they can deliver their production to their customers and receive their payment. Such requirements are generally lower for

business-to-consumer services like, for instance, in restaurants where the time lapse between the delivery of fresh food products and customers' payment is short. By contrast, liquidity ratios appear higher in industries characterised by longer production cycles, and therefore by higher working capital requirements, such as the manufacturing and the construction sector. Furthermore, chart 2 also indicates as strong heterogeneity of the liquidity position, whatever the sector considered. Various factors other than profitability can explain this heterogeneity like, for instance, the age of the firm (older businesses being more likely to have accumulated cash through their reinvested earnings), investment in financial assets (typically larger firms) or savings (to use for pending investment projects).

Chart 2

Firms' *ex-ante* liquidity position and cost adjustment with respect to sales fluctuations



Sources: Federal Public Service Finance, NBB.

1 The narrow liquidity ratio is defined as the ratio of the sum of trade credit and other loans granted by the firm, its cash reserves, and its current investment over its short-term debt.

2 A firm is considered non-profitable if it is aged 5 years or more and if its EBITDA (excluding extraordinary income and charges) has been less than its financial charges (or below zero if the firm has no financial charges) for three consecutive years.

3 Contemporaneous correlation between the shock to the variable considered (i.e. the monthly percentage change in 2020 compared to the corresponding month in 2019) and the shock to turnover over a period spanning from January to September 2020.

We now turn to the second factor affecting firms' resilience to a demand shock, which is their capacity to adjust their expenses to a sudden shock to their sales. If firms can reduce expenses immediately and proportionally whenever turnover drops, then the risk of running out of cash would be significantly mitigated. However, in practice, adjustments of expenses to turnover fluctuations are not instantaneous, irrespective of the sector considered. This is illustrated in the second part of chart 2 by the low (contemporaneous) correlation coefficients between the annual percentage changes in three types of expense categories – namely investment, consumption of services and purchase of intermediate goods – and sales. Consumption of intermediate goods turns out to be the most flexible expenditure component, while investment does not correlate with current sales. So, firms for

which investment decisions had already sunk by the time the crisis started were also among the most vulnerable to a depletion of cash reserves when the crisis hit.

1.3 Liquidity concept: cash requirements

In the previous sub-section, we showed how the pandemic led to sudden large drops in turnover in a large number of firms who were not always able to downscale costs in tandem with this decline. As a result, many firms experienced negative net cash flows. These negative net cash flows imply, mechanically, that their cash reserves are shrinking. Some firms might be able to overcome the pandemic-induced cashflow crunch solely by draining their cash reserves without making any other adjustments. Others may additionally choose to cut back on certain economic activities (such as advertising, investing and training of employees) or try to attract fresh external funding. For a number of firms, however, none of these actions suffice: the shock might be too large or too persistent, their initial cash balance might be too small, or they may fail to properly downscale activities. In all these cases, the firm would run out of cash.

In our framework, we focus on the firms' cash position as the key indicator of liquidity stress. More specifically, we produce an estimate of "free cash" at the end of each month, which reflects the cash balance that an individual firm has available after it has covered all of its operating costs (e.g. labour costs, intermediate inputs/services, rents, etc.), interest payments, taxes, debt repayments, etc. We refer to a company as having a "cash deficit" if its free cash turns negative: which we throughout also refer to as a cash "requirement" or "shortfall". Note that a cash deficit does not mean that the firm is bankrupt. It means that the firm currently has insufficient cash at its disposal to meet its current financial obligations (e.g. pay suppliers, landlords, etc.) and must resort to payment extensions and/or an additional funding.

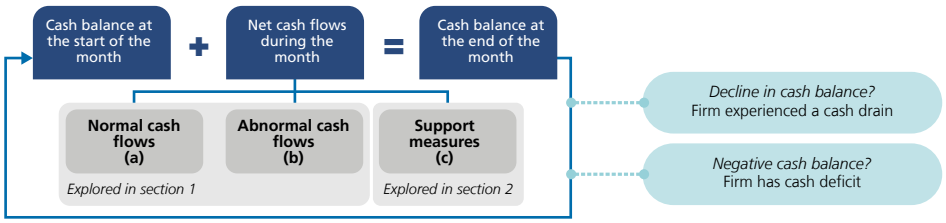
While there are various ways of quantifying liquidity stress of firms (see e.g. John (1993)), our notion of a "cash deficit" has – in the context of the pandemic – a few advantages over traditional measures (mostly accounting-based ratios). First, it is straightforward to interpret, transparent and quantified by other institutions, which allows for an international benchmarking of our results (see e.g. OECD (2020), European Commission (2020a,b), Bank of Italy (2020)). Such a comparison is included in the next section. Second, alternative liquidity stress measures typically rely on the discrepancy between the current liquidity position ("as is") and a desirable liquidity position (a steady-state target which ensures a medium/long-run going concern). The larger the discrepancy, the larger the liquidity stress. While useful, these measures implicitly involve two discretionary elements. On the one hand, they build on the subjective notion on what this desirable liquidity ratio should be. Since a cash deficit is by definition anchored around zero, our approach rules out that kind of discretionary choices. On the other hand, it is unclear over what time horizon this steady-state liquidity position should be attained. Imposing too short (long) a time frame overestimates (underestimates) the size of the liquidity problem caused by the pandemic. Finally, provided that a cash deficit quantifies the amount of cash to be replenished in order to secure the (short-run) survival of the firm, this liquidity concept is a more relevant (and uniform) benchmark to a policy-maker seeking to dampen the initial impact of the pandemic rather than to fully repair lost liquidity (and beyond).

1.4 The general logic of the framework

In order to analyse how the current pandemic might impact the firms' cash balance, we use the standard cash flow accounting identity depicted in chart 3. Starting from an initial cash position at the beginning of the month, we add the estimate of the evolution of cash flows during that month to arrive at a stock of free cash at the end of the month. Iterating across months (where the cash position at the end of the previous month equals the cash position at the start of the next month) enables us to flag individual firms with a cash requirement on a monthly basis. Moreover, firms with negative net cash flows are tagged to have a "cash drain". While the technical details of the framework are deferred to Annex A, a brief summary of the general logic is both instructive and instrumental for a correct interpretation of the quantitative results presented below.

Chart 3

Law of motion of the monthly cash balance



Source: NBB.

The monthly cash flows have three components: (a) cash flows that would accrue in normal (non-crisis) times, (b) abnormal cash flows that arise due to the COVID-19 crisis and (c) support measures received. Distinguishing normal cash flows (a) from abnormal cash flows (b) enables us to produce a counterfactual business-as-usual scenario. In this counterfactual scenario, firms sell, buy, borrow, invest, etc. at pre-pandemic rates. Assuming that many businesses will face cash deficits irrespective of the COVID-19 crisis, this counterfactual scenario makes it possible to isolate the marginal level of cash deficits caused by the pandemic. Component (c) enables us to identify the success of support measures in alleviating cash constraints.

In general, the outgoing cash flows in (a) and (b) encompass procurement of (intermediate) goods and services, wages, taxes, fixed assets, financial charges, reimbursements of bank loans, etc. Incoming cash flows typically include payments from customers, new bank debt, financial revenues, bond issues, etc. Support measures in (c) lead to incoming cash flows (or prevent outgoing cash flows).

How does one measure the various cash components (a), (b) and (c) in the face of lagged data availability? First, the no COVID-19 crisis cash flows in (a) for 2020 are estimated using standard techniques and represent a projection of historical incoming and outgoing cash flows into 2020. In order to quantify the support measures in (c), we rely on various granular and confidential data sources set out in section 2. Measuring (b), however, is more challenging. One prominent approach is to rely on a shock to firm revenues (e.g. taken from survey evidence) and simulate the impact of this revenue shock to all incoming and outgoing cash components (see Schivardi & Romano (2020) for a discussion). This perturbation procedure is prone to error for two reasons. First, Belgian accounting templates do not require small/micro firms (more than 95 % of the firm population) to report their sales and procurement of goods and services[1]. Second, properly estimating the extent to which firms can (or decide) to downsize costs/investment is challenging as it hinges, among many things, on the unobserved cost structure (fixed vs. variable), the ability of the firm to renegotiate pre-pandemic supply contracts, expectations about the future development of the crisis, etc. While we follow the aforementioned procedure for some minor cash components, we depart from this method in view of timely, confidential firm-level VAT declarations made available to us. In this data source, we directly observe monthly firm-level sales, procurement of intermediates/services and investment up to September 2020. This sidesteps the need to estimate these flows[2].

In order to ensure a correct interpretation of the quantitative results below, we close this section with a discussion of the sample selection. First, as the estimation of the framework requires information from the annual accounts, we focus exclusively on firms that file such accounts. This, by definition, excludes the self-employed who are not

1 Size criteria determine the format that should be used for filing annual accounts. Only large firms file full formats. In order to determine the size of a firm, three parameters are relevant: the size of the workforce (50 FTE), turnover (€ 9 000 000) and total assets (€ 4 500 000). A company is considered large if it exceeds either two or three of the thresholds or is listed on the stock exchange.

2 While property rent is not included in the VAT declarations, it enters the analysis through the normal cash flow component. This implies that we assume rents to remain fully due throughout 2020.

required to file annual accounts by Belgian generally accepted accounting principles (GAAP). Second, we exclude certain sub-sectors, if their behaviour is not properly accounted for by our framework. These sectors include, *inter alia*, financial and insurance activities, public administration, education, human health and social work activities [1]. Moreover, we exclude 'dormant' firms from the analysis (i.e. firms that have not filed VAT declarations in the last two years while legally required to do so) and drop companies as soon as they are formally declared bankrupt (so as not to mechanically compound liquidity needs of firms that no longer exist). The above selection criteria resulted in a sample of 403 770 non-financial corporations in March 2020.

1.5 Quantitative results (before taking into account policy measures)

This sub-section summarises the main quantitative results. It first takes an aggregate perspective, followed by a set of micro-level results. The monthly estimates run from March 2020 up to September 2020. They disregard policy support measures and therefore sketch the impact of the pandemic on firm liquidity needs in the absence of any attenuating policy measures. Their impact is studied in section 2.

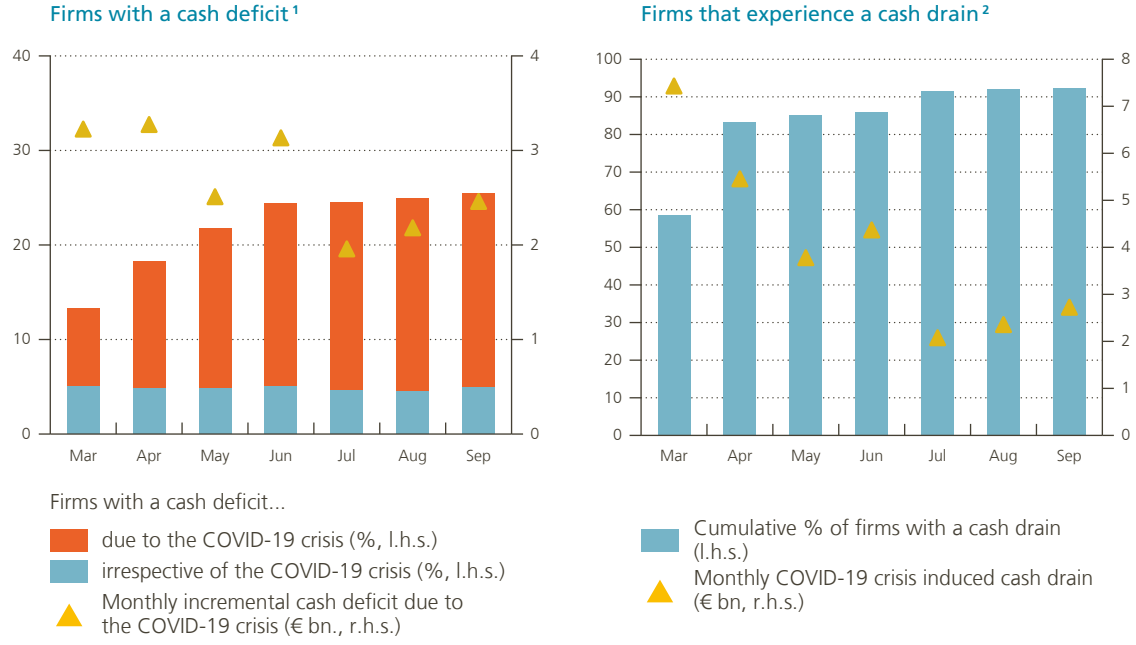
The left panel of chart 4 depicts, on a monthly basis, the share of firms flagged to have a cash deficit in the absence of policy interventions. The figure distinguishes between (a) the marginal cash flow deficit due to the

1 See Annex C for an exhaustive list.

Chart 4

Impact of the COVID-19 crisis on firm-level cash deficits

(Before taking support measures into account)



Source: NBB.

1 A firm has a cash deficit if its estimated cash balance turns negative.

2 A firm has experienced a cash drain if it had to draw down its pre-pandemic cash position.

COVID-19 crisis and (b) the counterfactual cash flow deficit that would have existed irrespective of the COVID-19 crisis. Under the latter scenario, chart 4 documents that around 5 % of the total number of firms will feature cash deficits irrespective of the COVID-19 crisis. Due to the pandemic, however, an additional 20 % of firms have drained their cash reserves to the point where they have a need for additional liquidity (by September 2020). These cash concerns built up very quickly during March and April and levelled off during the summer (the observed plateau is consistent with the ERMG survey responses).

Note that a cash requirement is a very narrow indicator of liquidity stress. It excludes firms for which liquidity is tight, but still sufficient to meet current liabilities. While the left-hand side figure remains mute on this issue, the right panel of chart 4 shows that, by September 2020, 90 % of the firms have, at least once during the period of analysis, dipped into their pre-pandemic cash reserves[1]. A little over 80 % of businesses had already addressed their reserves two months into the crisis. Quantitatively, without policy interventions, the total drop in liquidity due to the COVID-19 crisis accumulates up to € 28.2 billion by September 2020, of which € 17.2 billion leads to an actual cash deficit.

The aggregate scenario conceals a significant amount of heterogeneity at the micro level. For instance, we noted in the left panel in chart 2 that many firms already exhibited a fragile liquidity position prior to the COVID-19 crisis. Given a weaker buffer, these firms are more likely to be cash-deprived due to the pandemic. How much more likely ? The upper left panel in chart 5 clusters firms in ten equally sized groups, per decile of pre-pandemic liquidity (defined as the working capital ratio). The 10 % least (most) liquid firms within each sector are contained in bin 1 (10). The binning focuses on relative liquidity compared to sector peers. This panel documents that the 10 % of firms with the least comfortable initial liquidity level were almost twice as likely to end up with cash problems than the median firm in that sector due to the COVID-19 crisis. Importantly, the figure conveys that having a more solid cash position than the sector peers does not guarantee avoiding a cash shortfall : +/-15 % of firms with an above median liquidity position (bin 6 to 10) still faced cash shortage. Were the illiquid firms hit especially hard by the COVID-19 crisis ? At first, it seems that the exceptional, unanticipated nature of the crisis makes this unlikely. While the pandemic hit certain sectors, or certain businesses, disproportionately, there is no obvious reason to expect that firms illiquid prior to the pandemic would be affected more. However, the chart indicates that, on average, firms with a weaker initial liquidity position also reported larger declines in turnover during the March-September period. Potentially, a dire liquidity position constrained them in taking corrective action compared to their more liquid sector peers (e.g. set up an online web shop, invest in health and safety measures, etc.). Alternatively, it could indicate that poor pre-pandemic liquidity-management correlates with poor (crisis-)management.

The upper right panel reports the cash deficits due to COVID-19 on a sector-level basis (in the absence of policy measures). It turns out that 46 % of surveyed businesses operating in the personal service sectors, such as Hairdressing, beauty and wellbeing, are flagged to have a cash requirements in September 2020 due to the pandemic. Dire liquidity positions were also present in the Food and beverage service sector (44 %), Sports and recreation (37 %), Accommodation (36 %) and Creative activities, arts and culture (33 %). Not surprisingly, these sectors had experienced the largest (cumulative) drop in turnover by September. But this is not the whole story. The relatively large discrepancy between the cumulative turnover decline and cumulative drop in costs also highlights that these sectors were the least able to scale down the cost side of operations (e.g. because they have a larger fixed cost structure, non-negotiable long-term contracts, etc.). Other sectors (e.g. Manufacturing, Agriculture, Retail trade of food products) not only experienced smaller fallbacks in turnover, they were also more able to restrain their costs in line with turnover. Finally, cash-constrained sectors significantly reduced their investment. While this strategy saves on cash, it is likely to put a drag on future growth and productivity of firms within these sectors.

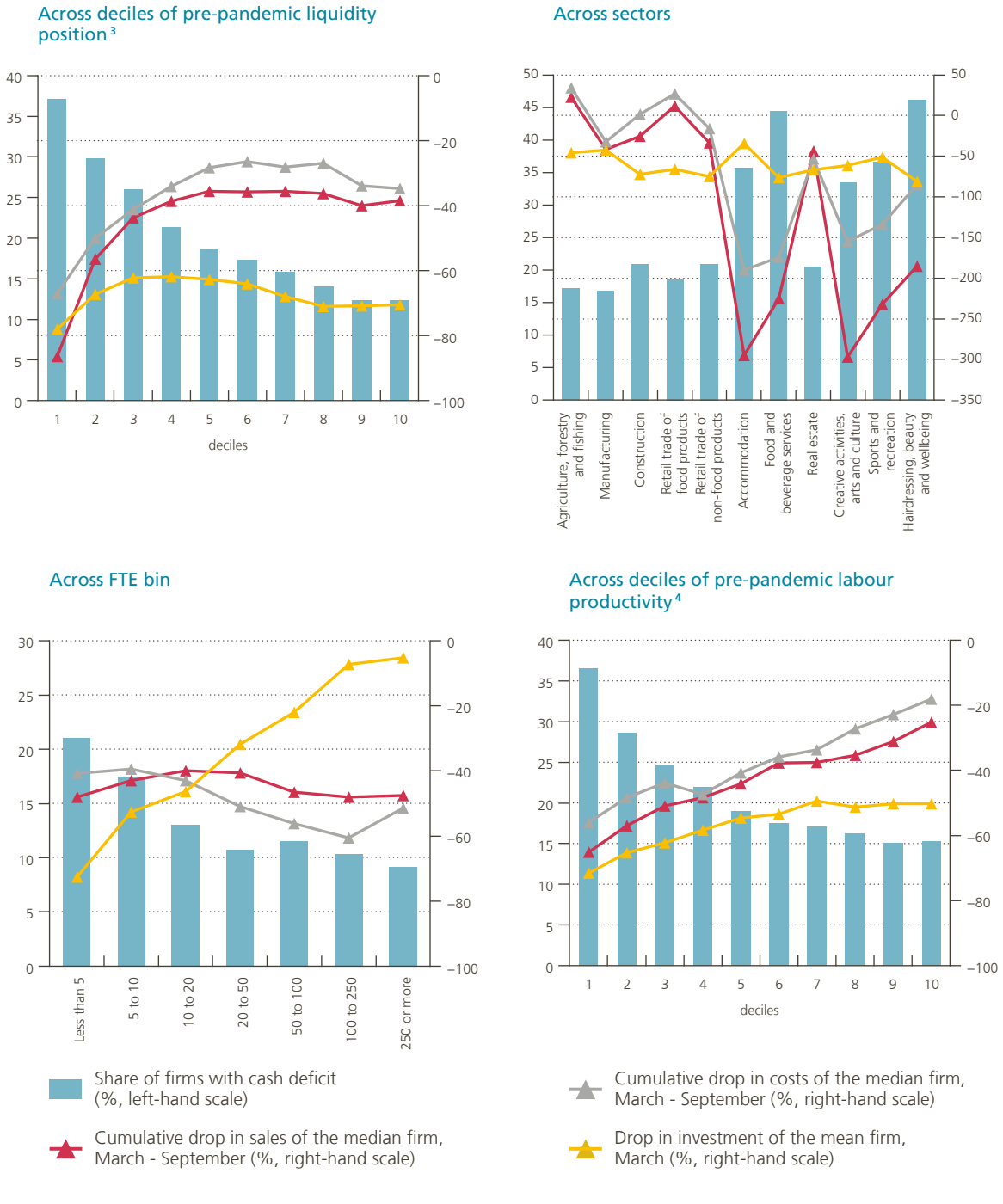
1 Note that it is difficult to link this result to the responses from the ERMG survey. In this survey firms are asked the question "Do you have liquidity problems ?". While a cash deficit by definition qualifies as a liquidity problem, this is not the case for a cash drain.

In terms of firm size, the lower left panel shows that approximately one out of five firms with less than five full-time equivalent employees faced urgent liquidity problems. At least two ingredients add to this result. First, while small firms reported similar declines in turnover to large firms during the time frame under consideration, smaller firms seem to be less successful in downscaling costs (e.g. because they have less power to renegotiate contract terms with suppliers than larger firms). Second, small firms typically had a smaller pre-pandemic liquidity buffer to use up. While small firms disproportionately reduced their investment rates compared to larger firms, they were still more likely to end up with liquidity concerns.

Finally, the experience of the global financial crisis and sovereign debt crisis has shown that large-scale government interventions may enable firms to survive, but may also create 'zombies' – i.e. firms that in normal circumstances would exit due to poor performance (McGowan *et al.*, 2018 : De Jonghe *et al.*, 2020). While there are arguments for limiting business closures at least in the short run (supply chain disruptions, knock-on effects in banks' credit portfolios, massive unemployment), long-run unconditional blanket support measures can generate misallocation. After a large economic dislocation, unproductive firms are typically wiped out and replaced by new, more productive entrepreneurs – Schumpeterian creative destruction, in economic parlance (Restuccia and Rogerson, 2017). If too much unconditional support is offered for too long, this process of renewal and growth is undermined. In that context, the lower right-hand panel classifies firms according to their pre-pandemic labour productivity in ten bins (where the 10 % least (most) productive firms within each sector are contained in bin 1 (10)). The chart shows that the 10 % least productive firms within the sector were more than twice as likely to face cash problems than the median firm in that same sector. The pattern emerging in the lower right panel indicates that exit of the most illiquid firms on average would imply exit of the least productive firms.

Chart 5

Cash deficits due to the COVID-19 crisis[1] and cumulative change in turnover/costs/investment[2]



Sources: Federal Public Service Finance, NBB.

1 A firm experiences a cash deficit if its cash balance is negative.

2 Cumulative sum of the monthly percentage change in 2020 compared the corresponding month in 2019.

3 We cluster firms according to their narrow liquidity ratio in deciles (first decile = least liquid ="1", tenth decile = most liquid ="10").

4 Defined as the ratio of value added over labour. We cluster firms according to their labour productivity in deciles (first decile = least productive ="1", tenth decile = most productive ="10").

2. Keeping the lights on: the impact of policy measures

"Christmas lights, when I was a kid, were wired in series. If one lightbulb blew, the whole string went dark. My Depression era parents taught me to fix it by checking each bulb, one-by-one, all one hundred of them. The tree was dark for a long time. But since bulbs were expensive and labour was cheap back then, the prolonged darkness was worth it. Today, I would do it differently. I would tend towards a 'costly but quick' option, say, replacing all bulbs at once. After all, goods are cheap, labour is expensive, and Christmas is short.

I suggest that policymakers think about the 'economic medicine' for the COVID-19 crisis in the same way. Governments should choose quick options that keep the economy's lights on without worrying too much about costs."

– Richard Baldwin, ex-President of the Centre for Economic Policy Research (March, 2020)

Belgian authorities have taken swift and decisive measures to alleviate the liquidity shortfall of non-financial firms. In this section, we assess to what extent these interventions have had an effect on firms' cash deficits, as measured and discussed in the previous section. For parsimony and practical considerations, we restrict the analysis to the set of measures that (i) can be quantified with reasonable accuracy, (ii) are currently in place (i.e. not tentative but cast and approved in legislation), (iii) are the most sizeable at the macro level and (iv) are taken at the federal/regional level (thereby excluding, *inter alia*, the EU Recovery and Resilience Facility, the European Investment Fund, etc.)[1]. Imposing this filter narrows the set of studied interventions which, in turn, bring forward the disclaimer that the results provide a lower bound on the impact of policy measures.

This section is structured as follows. We first discuss three broad classes of Belgian support measures (financial sector measures, outright transfers and fiscal interventions) and briefly highlight the policy measures not taken on board. The second sub-section is devoted to a quantitative evaluation of the support packages and scrutinises the role of the banking sector as a lender of first resort. We subsequently take stock of the residual, post-intervention, liquidity problem and conclude this section with an international cross-country comparison.

2.1 Policy measures

2.1.1 Financial sector policy measures[2]

The financial sector constitutes a crucial lever for tackling and resolving the current crisis. Upon the initiative of the Minister of Finance and with the support of the National Bank of Belgium, the federal government has drawn up an agreement with the financial sector to help attenuate the impact of the coronavirus pandemic on firms through the introduction of two support schemes: a debt moratorium (for pre-COVID-19 existing credit facilities) and State-guaranteed loans (for new credit lines). In order to monitor use of both schemes, the NBB keeps an exhaustive list of all credit under moratorium and new loans granted under the State guarantee scheme. This new data source complements the Central Corporate Credit Register (CCCR), already in place prior to the pandemic, which documents all used and authorised loans from banks to non-financial corporations. Taken together, both data sources enable us to quantify the extent to which the financial sector support measures have supplemented traditional credit intermediation to attenuate businesses' cash shortfalls.

1 Criterion (i) is mainly driven by data availability. Criterion (ii) only applies for the projections considered in section 3. Criterion (iii) builds on an NBB in-house database which lists federal and regional policy measures as well as estimates of their budgetary implications. We qualify a measure as sizeable if its budgetary impact exceeds € 250 million. Finally, criterion (iv) reflects our aim to keep the analysis parsimonious and self-contained.

2 Extensive details on financial sector policy measures can be found in NBB (2020a).

Debt moratorium: debt rescheduling

Under the debt moratorium, viable firms can apply to their institutional lenders for a deferral of repayments on their business loans for a maximum of six months. The suspension only applies to the principal: the interest on these loans is still due. Once the deferral period has lapsed, payments have to resume. The duration of the loan will be extended by the deferral period and borrowers will finish repaying their loan a maximum of six months later than the original deadline. Credit institutions are not allowed to charge any application or administrative fees for the use of this deferral.

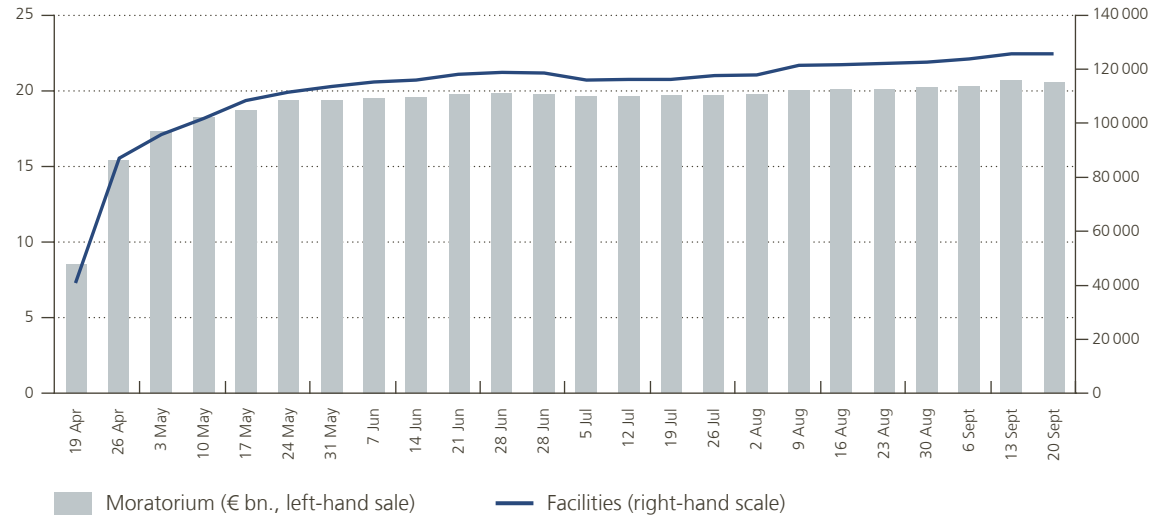
Not all firms can ask for a moratorium on their debt as important eligibility criteria apply[1]. These include, *inter alia*, that payment problems should be caused by the COVID-19 crisis, i.e. through (i) a drop in turnover or activity, (ii) recourse to (temporary) unemployment, or (iii) the obligation imposed by governmental authorities to close the company or organisation. Moreover, the requesting firm may not have been in arrears on 1 February 2020 with its outstanding loans, tax or social security contributions (or it was less than 30 days late in paying them on 29 February). In addition, it must have fulfilled its contractual credit obligations with all credit institutions in the last 12 months prior to 31 January 2020 and is not undergoing an active credit restructuring process.

From its inception in mid-April, this instrument was often solicited by Belgian firms. Chart 6 shows that, already by the end of April, 86 000 debt facilities were placed under moratorium which concerned a total amount of € 15 billion (excluding self-employed and public entities). Near the end of September 2020, 115 000 loans were under moratorium, with a total worth of € 22.5 billion. For a correct interpretation of our results presented below: what firms save on outgoing cash flows, however, is not the principal but the size of the now postponed monthly reimbursement.

1 See NBB (2020a) for an exhaustive list.

Chart 6

Use of debt moratorium[1]



Source: NBB.

1 Excluding self-employed and public entities.

State-guaranteed loans

A first guarantee scheme was activated for all new loans and credit lines with a duration of up to 12 months that credit institutions granted to resident firms for their activities in Belgium. It was possible to apply for the scheme from the start of April 2020 up to 30 September 2020 and a € 50 billion buffer has been set aside for cases where instalments cannot be paid. This guarantee scheme was later extended in order to include loans – exclusively to SMEs – with a duration up to 36 months. As with the debt moratorium, several eligibility criteria apply, the most important of which relates to the viability of the firm[1]. Uptake of this support measure has remained relatively limited.

2.1.2 Outright transfers

Nuisance premiums/compensation premiums

Firms forced to cease operations by law were eligible to receive a one-off nuisance premium. The eligibility criteria varied across Regions and the premiums ranged between € 2 000 and € 5 000. Moreover, businesses that were not legally required to halt operations but nonetheless experienced a significant decline in turnover (i.e. more than a 60 % decline in sales) were entitled to a one-off compensation premium. Both premiums are mutually exclusive. Based on firms' monthly VAT returns and location data, we infer the size of premium received. Note that we do not observe firms soliciting this premium. Below, we assume rationality on the part of the firm and assume it applies for it when eligible.

Temporary unemployment

In general, when a firm files for temporary unemployment, its employees receive benefits from the unemployment authority, and the firm can save on wage outlays. In the context of the COVID-19 crisis, a simplified procedure for temporary unemployment was approved by the government on 20 March 2020. All temporary lay-offs due to COVID-19 are considered as a case of *force majeure*, and the company is not required to cease activities completely. In practice, this means that some employees may be temporarily unemployed, and others may not. Our analysis makes use of data on firm-level temporary unemployment received from the National Unemployment Office (NEO) to proxy savings on the wage bill.

2.1.3 Fiscal measures

A one-off carry-back regime

For the first time in Belgian tax history, a general one-off carry-back regime was introduced by law for losses incurred by Belgian firms. Provided that certain conditions are met, this crisis measure enables taxpayers to speed up the use of their losses, by offsetting (estimated) COVID-19 losses against taxable profits (if any) from the prior financial year, i.e. the "pre-COVID-19 year". For one financial year (the pre-COVID-19 year), taxpayers will be able to temporarily exempt (part of) their taxable profit by the amount of the estimated COVID-19 losses[2]. In doing so, the tax burden for the pre-COVID-19 year will be lower and any tax pre-payments made in excess of this tax burden will be reimbursed in the course of the COVID-19 year. This is expected to improve the liquidity position of firms. However, in order to reclaim advance payments on part of their pre-crisis profits, companies have to predict their losses as a result of the COVID-19 crisis. Penalties apply if losses are overestimated by 10 %. In our analysis, we make use of VAT data (up to September 2020) to proxy losses due to the crisis (and extrapolate them to the full COVID-19 year). We subsequently assume that firms fully apply for the carry-back system.

1 In this context, viable firms are firms that are not considered as 'undertakings in difficulty', within the meaning of EU Regulation No. 651/2014.

2 The exemption cannot exceed the result for the tax period and is subject to a limit of € 20 million. If there is no loss in the next tax year, or if the loss is less than the amount for which exemption was requested, a penalty may be imposed in the form of a tax increase (10 % tolerance is applicable).

Exemption of the withholding tax

In severely affected industries that had to resort to temporary unemployment (see above), firms are granted a partial exemption from payment of withholding taxes[1]. This provides an incentive to have employees, who are currently temporarily laid off, returning to the workplace. More specifically, from June to August, 50 % of the increase in withholding taxes compared to what was paid in May 2020, will be forgiven.

Investment deductibility

To encourage investment, firms subject to corporate taxes are usually eligible for an investment deduction. Conceptually, this comes down to an additional tax deduction on top of that on amortisations. In the context of the COVID-19 crisis, the standard investment deduction has been raised from 8 % to 25 % for investment made between 12 March 2020 and 31 December 2020. Based on VAT declarations, we can quantify the size of this support measure.

2.1.4 Other measures not taken into account

A set of policy measures fall outside the scope of the analysis. This list includes a moratorium on bankruptcies, introduced to give firms a better opportunity to survive. Moreover, a "recovery reserve" enables companies to reduce their accounting profits from tax years 2022, 2023 and 2024 by creating a tax-free reserve up to the losses incurred in 2020. Such measures are expected to strengthen the solvency position of firms and affect liquidity (beyond the time horizon of the current analysis). Furthermore, this article shares a common thread with the current literature in the sense that it focuses exclusively on policy measures directly targeted towards firms. While support packages that target households also fuel demand for goods/services (and therefore indirectly support firm liquidity), we refrain from quantifying these indirect effects.

Acknowledging that the crisis affects some sectors disproportionally, various levels of government have advanced a set of sector-specific support measures. While these support measures potentially play an important role in alleviating liquidity stress in particular segments of the economy (most notably in Creative activities, arts and culture, Sports and recreation, Food and beverage services), they are both numerous and their exact allocation among firms is unobserved which makes it impractical accounting for them.

Finally, some crucial measures fall outside the scope of our analysis as they only apply to businesses we do not consider. Most importantly, the self-employed (who are not required to file annual accounts, under to Belgian law) are entitled to a replacement income, exempt from social security contributions (which implies that they do not build up social rights for the exempt period), bridging loans, etc. Although the self-employed account for 17 % of total employment, we refrain from incorporating their liquidity requirements as the absence of annual accounts renders such an estimation prone to error.

1 A withholding tax is the amount that an employer withholds from employees' wages and pays directly to the Federal Public Service Finance. The amount withheld is a credit against the income tax the employee must pay during the year.

2.2 Quantitative results

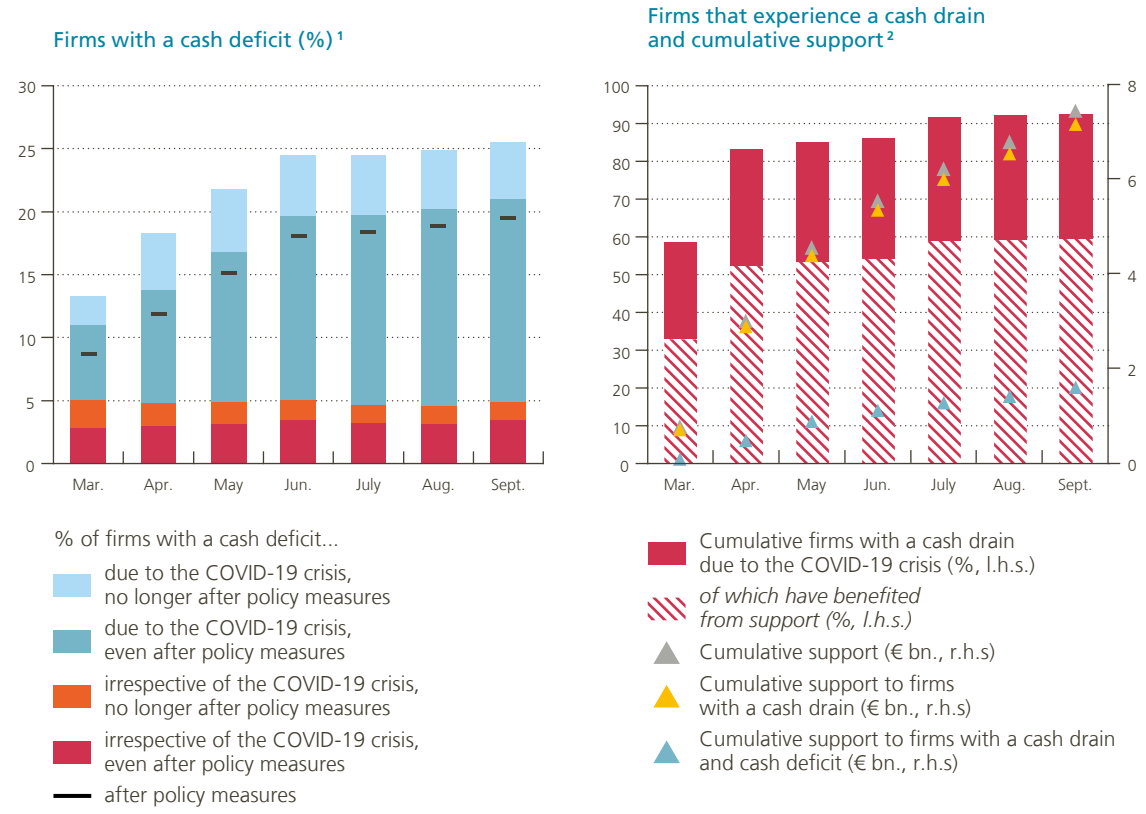
2.2.1 Impact of support measures

The first panel of chart 7 extends the analysis of the previous section and quantifies the share of firms that are no longer cash-constrained after they have benefited from policy interventions. While the COVID-19 crisis caused an acute cash deficit for 20 % of all firms in September 2020, 15 % still have a cash shortfall after receiving policy support. The bulk of the measures are documented to have a benign effect early in the crisis (underscoring the speed of the intervention), which persisted over the summer. Moreover, policy support only marginally solves the cash deficit of firms that would have developed cash shortages irrespective of the COVID-19 crisis. This is true, both because these firms proportionally receive less aid (as they are not eligible : see the discussion above) or have developed too large a cash shortfall that cannot be dampened by the level of support made available in the COVID-19 crisis.

The second panel of chart 7 shows that, by the end of September 2020, € 7 billion of policy support was provided to the business population under consideration (markers in grey). Importantly, the minor discrepancy between the grey and yellow markers reveals that virtually all of this support accrues to firms that effectively experienced a cash drain. This follows naturally from the fact that most of the support measures are conditional

Chart 7

Impact of support measures



Source : NBB.

1 A firm has a cash deficit if its estimated cash balance turns negative.

2 A firm has experienced a cash drain if it had to reduce its pre-pandemic cash position.

on being negatively affected by the COVID-19 crisis[1]. Not surprisingly, only a fraction of total support accrues to firms with a cash shortfall as none of the studied support measures require the firm to have an effective cash deficit.

Finally, while 90 % of the firms under consideration had experienced a cash drain by September (red bars), approximately two out of three firms with a cash drain have benefited directly from (at least one type of) support measures (shaded red area). So, support either solves or reduces the size of a cash deficit (as shown in the first panel of chart 7) or, in the absence of a cash deficit, it strengthens the liquidity position of those that experienced a cash drain, potentially preventing a cash shortfall in the future (as is clear from the second panel of chart 7).

The upper left panel of chart 8 documents that policy interventions have had a heterogenous effects across sectors. While the severely impacted sectors (Creative activities, arts and culture, Accommodation, Sports and recreation, Food and beverage services and Hairdressing, beauty and wellbeing) would have developed more severe cash shortfalls without any intervention, policy support has successfully attenuated liquidity concerns in a large number of establishments in these sectors (disproportionately more so compared to other sectors). These highly affected sectors are typically populated by relatively small firms, with – on average – a limited nominal cash shortfall, albeit substantial relative to their size. In that case, support measures that are not tailored to firm size (such as the nuisance or discomfort premiums) succeed in alleviating cash concerns of many small entities in these sectors. This is attested in the top right panel, where liquidity stress was attenuated proportionally more in smaller firms than large firms.

The bottom left panel decomposes the total support received within each sector by type. It documents that most aid is provided through temporary unemployment and nuisance or compensation premiums. Financial sector support measures are of second-order importance (with debt moratorium typically more important than State-guaranteed loans). Finally, fiscal measures are of marginal importance and mainly reflect the exemption of withholding taxes. As higher investment deductibility only works if firms effectively invest, this package is of limited size in an environment of falling investment. Moreover, the carry-back tax system is only expected to improve liquidity in the last quarter of 2020, which falls outside the scope of the analysis. Finally, while the bottom right panel unveils the obvious message that firms with more employees relied disproportionally more on temporary unemployment, it also indicates that nuisance premiums were the second source of support obtained by small firms. For large firms, alongside the temporary unemployment scheme, financial sector support was the key source of liquidity relief.

1 This is true for State-guaranteed loans (see paragraph 3.30 in NBB (2020a)), with minor exceptions (see paragraph 3.15 in NBB (2020a)). For the moratorium on debt, eligibility criteria require payment problems to be caused by COVID-19, i.e. through (i) a drop in turnover or activity, (ii) recourse to (temporary) unemployment, or (iii) the obligation imposed by governmental authorities to close down the company or organisation (NBB (2020a), paragraph 2.2). So, firms have access to this relief programme if they experience a cash drain (but not necessarily have a cash deficit).

Chart 8

Impact of the COVID-19 crisis on firm-level cash deficits and policy mix decomposition

Source: NBB.

1 A firm has a cash deficit if its estimated cash balance turns negative.

2.2.2 Banks: lenders of first resort

In chart 8, both State guarantees and debt moratoria are classified as policy-coordinated support packages accruing from the banking sector. Credit obtained from banks through normal, market-based, financial intermediation procedures is not classified as a support mechanism. The question remains as to what extent this market-based (as opposed to policy-coordinated) financial intermediation has eased liquidity concerns of firms.

This question is important, provided that considerable policy action has been taken to support the capacity of the banking sector to fulfill that role, e.g. through monetary policy actions (see Boeckx *et al.*, 2020) and macroprudential interventions through the release of the full Pillar 2 Guidance buffer, the capital conservation buffer (ECB, 2020) and the countercyclical capital buffer (NBB, 2020c).

In order to investigate the role of banks as liquidity providers during the COVID-19 crisis, we quantify the share of businesses that would be cash-constrained had they not received fresh funding from banks (even though they did benefit from the various support measures discussed above). To that end, we classify each firm according to the type of new bank loan it has received:

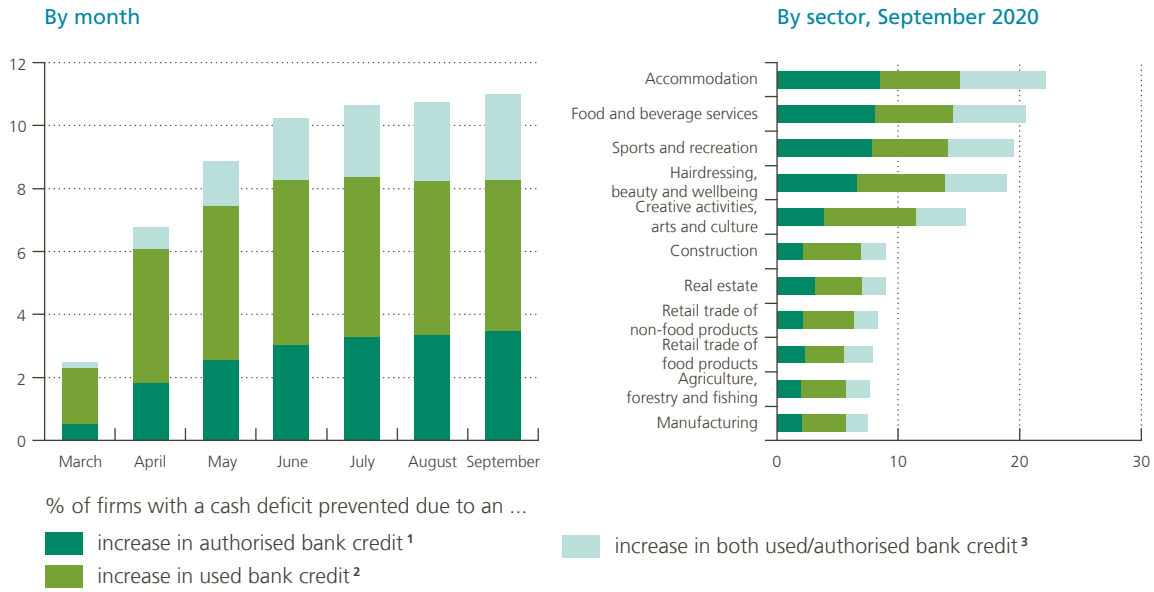
- First, firms that exclusively draw on credit lines that existed prior to the pandemic. This reflects use of credit lines that were already authorised by their incumbent bank(s) but were not fully exhausted before the pandemic. Such authorised amounts reflect prior commitments by banks to lend to the firm at pre-specified rates, up to pre-specified limits and conditional on a set of debt covenants. Hence, these drawdowns purely reflect firms' demand and, in principle, involve no active intervention from the bank.
- Second, firms that obtained new (or expanded pre-pandemic) authorised credit lines and subsequently partially/fully drew on this higher authorised amount. This includes both firms expanding existing credit contracts with incumbent banks or firms establishing one or multiple new banking relationships. This category of credit represents active supply behaviour of banks and directly speaks to the question whether banks actively helped firms in attenuating liquidity shortfalls.
- Third, firms that combine both actions (i.e. a hybrid category).

Chart 9 shows that the Belgian banking sector has contributed to dampening the liquidity deficits of firms. First, passively, through drawdowns of pre-pandemic authorised lines by mainly large non-financial corporations.

Chart 9

Impact of bank credit on cash deficits

(% of firms)



Source: NBB.

1 If the firm exclusively draws within the authorised limits of credit lines that already existed before the pandemic.

2 If the firm exclusively draws on new authorised credit lines that did not exist prior to the pandemic.

3 If the firm draws both on pre-pandemic authorised lines and also on new authorised lines of credit (combination of other categories).

By the end of April 2020, an additional 5 % of Belgian firms would have faced a cash deficit had they been unable to intensify use of pre-pandemic borrowing limits. Note that such drawdowns of authorised credit during COVID-19 is not specific to the Belgian context (see Li *et al*., 2020)[1]. Second, banks have contributed by raising authorised amounts. By the end of September 2020, an additional 5 % of firms averted a cash deficit by expanding and subsequently drawing on expanded/new authorised lines. These effects had already emerged in March and April and came to standstill afterwards[2].

The second panel delves deeper in the underlying sectoral heterogeneity. It documents that the Manufacturing, Construction and Retail trade sector disproportionately drew on pre-pandemic credit lines. These patterns to a large extent reflect pre-COVID-19 utilisation rates. More precisely: prior to the pandemic, firms in these sectors typically reported lower utilisation rates compared to firms in other sectors (NBB, 2020b). As such, these firms had more slack in their credit lines to exhaust compared to other firms. Moreover, we find that mainly larger firms extensively drew on authorised credit lines to satisfy their cash requirements (proportionally more so than smaller businesses), which again reflects pre-COVID-19 utilisation rates. Chart 9 also reveals that market-based bank credit inflows to firms were more important than new State-guaranteed loans.

Taken together, in contrast to the situation at the time of the 2007-2008 financial crisis, when the fragility of banks' balance sheets had been a significant catalyst of the crisis, during COVID-19, the banking sector has cushioned the initial impact of the pandemic on the liquidity needs of (particularly large) firms in March-April, while this role attenuated afterwards. While the moratorium on bank debt was a successful tool to reduce outgoing cash outflows, the bulk of fresh incoming bank credit was produced under regular market forces rather than under the State guarantee.

2.3 Who has received what type of support?

A budget-constrained policy-maker should aim to support firms that (a) have been deprived of cash by the pandemic and (b) have business models that are sustainable after the COVID-19 crisis. The first criterion implies that scarce resources should target firms with a cash drain that is actually attributable to the pandemic (and not replenish liquidity needs existing prior to/irrespective of the crisis). The second objective should allow for some degree of creative destruction so that firms with non-viable business models are either reorganised or liquidated. As per the quote in the introduction, the support measures during the first wave mostly aimed to keep firms afloat in order to "keep the lights of the economy on". It is insightful to investigate to what extent the policy measures taken meet these two criteria.

To investigate the first dimension, the first bar in the top panel of chart 10 classifies firms according to whether they experienced a cash drain and highlights the sub-set of firms for which the pandemic-induced cash drain has led to a cash deficit (without policy interventions). The centre part shows, per type of support measure, the share of each category in the total number of firms that received each support measure. The last part quantifies, per type of support measure, the proportion in total support received by each firm category. The centre and right-hand part of the chart show that debt moratoria are disproportionately used by firms that faced a cash deficit due to the pandemic: while 20 % of the corporate population flagged up a cash requirement due to the COVID-19 crisis, these firms reflect 32 % of total firms that benefited from the moratorium and 47 % of the total moratorium volume. In terms of volume, virtually all debt under moratorium is held by firms that have experienced a cash drain. The observation that firms without a cash drain have close to zero usage is hardwired in the eligibility criteria: it is only available to firms with payment problems clearly attributed to the COVID-19

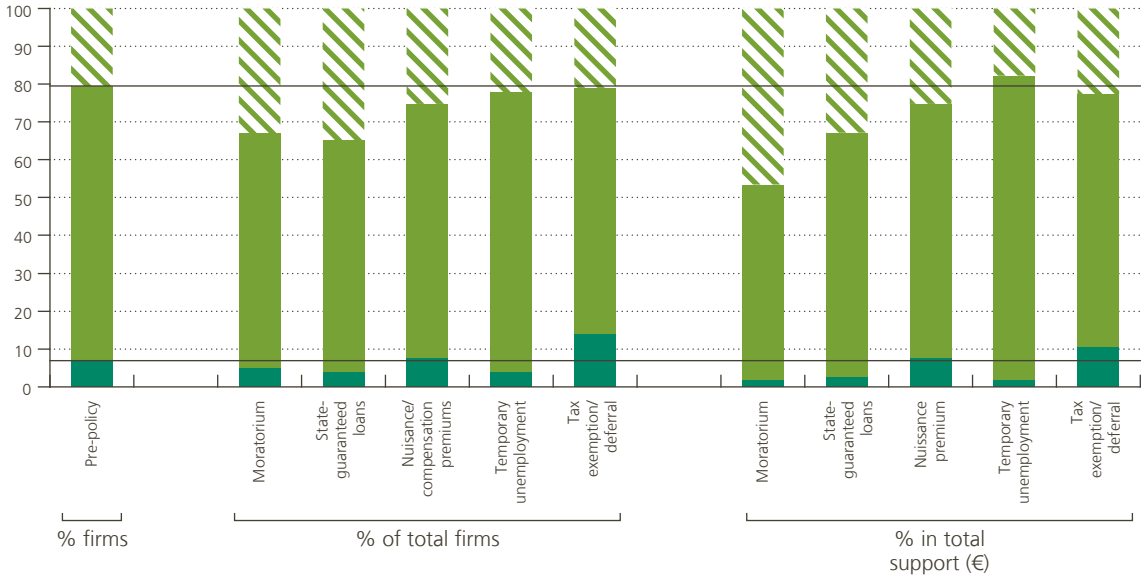
1 Moreover, such behaviour was also observed during the global financial crisis, both in Belgium (NBB, 2010) and internationally (e.g. Ivashina & Scharfstein, 2008).

2 Note that this pattern is consistent with the Survey on the access to finance of enterprises (SAFE), in which Belgian SMEs, in line with the rest of the EA, flag up a deterioration in access to bank finance during the April-September period.

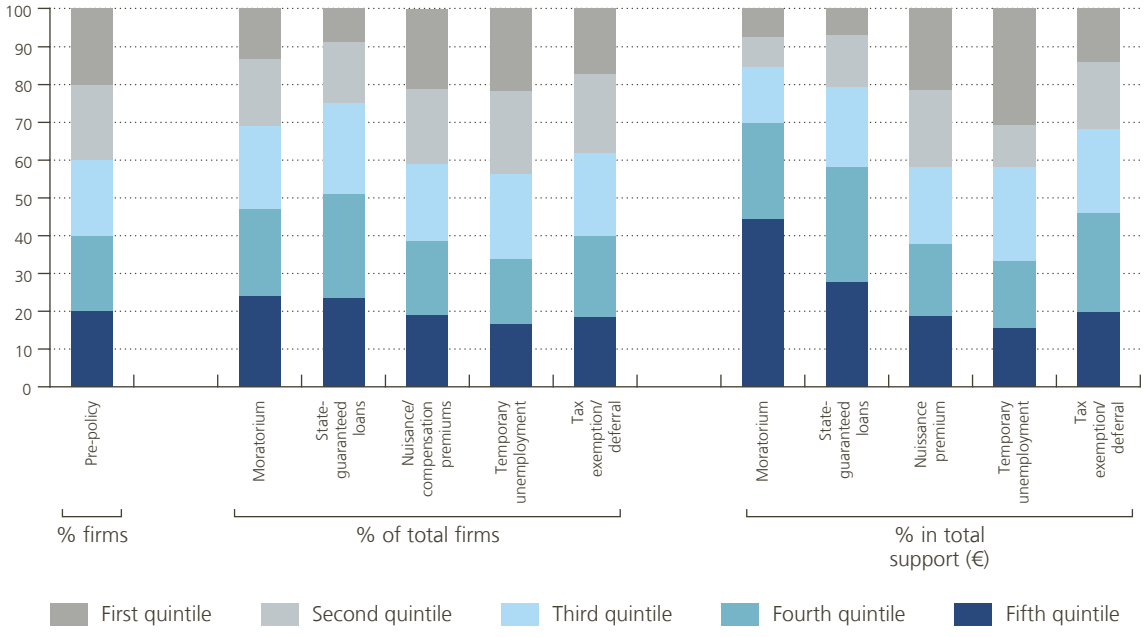
Chart 10

Allocation of support measures

Allocation of support over firms facing a cash drain or not (without support) over the period March 2020 to September 2020



Allocation of support over deciles of labour productivity 3



Source: NBB.

1 A firm has experienced a cash drain if it had to reduce its pre-pandemic cash position.

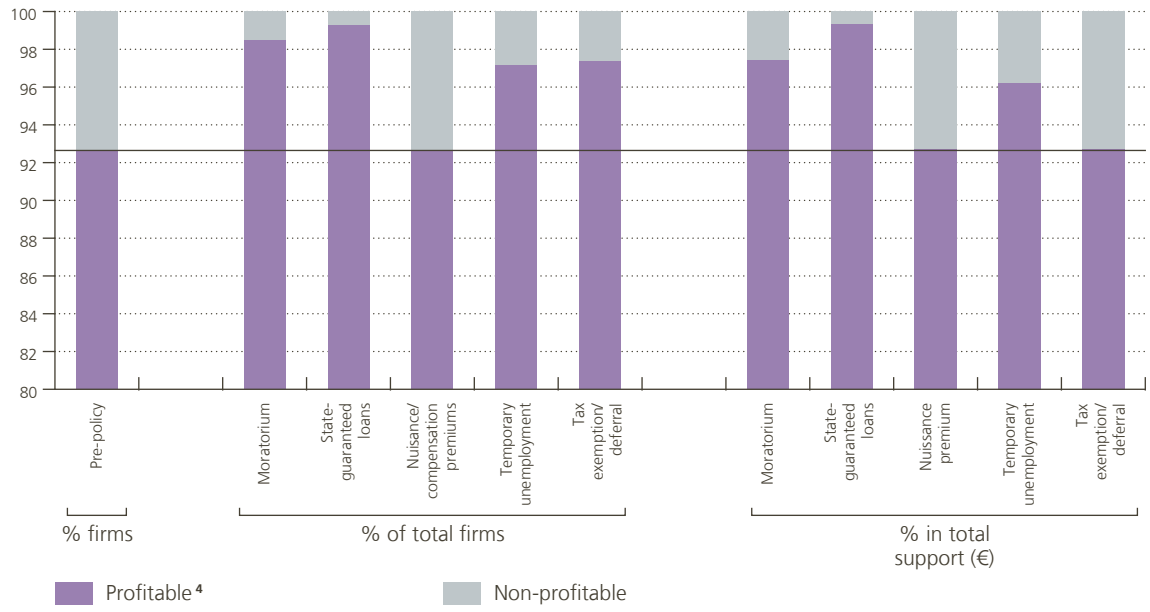
2 A firm has a cash deficit if its estimated cash balance turns negative.

3 Labour productivity. Quintile five (one) contains the most (least) productive firms in their sector.

Chart 10 (continued)

Allocation of support measures

Allocation of support over profitable and non-profitable firms



Source: NBB.

4 A firm is considered non-profitable if it is aged five years or more and if its EBITDA (excluding extraordinary income and chargers) has been less than its financial charges (or below zero if has no financial charges) for three successive years.

crisis (see above). A similar message applies to State-guaranteed loans, where the liquidity deprived firms reflect 35 % of all State-guaranteed loans and 33 % of its volume.

Moreover, while nuisance and discomfort premiums by and large accrue to firms which experienced a cash drain, 8 % of its volume flows to firms that have not experienced a decline in its cash position since the start of the pandemic. Two non-mutually exclusive explanations apply. First, it can simply mean that nuisance/discomfort premia accrue to firms that do not necessarily need them (e.g., firms are eligible because their sales drop breached the –60 % threshold due to an exceptional good reference period last year). Alternatively, they accrue to firms that are affected by the COVID-19 crisis, but which have taken corrective action so as to avert a cash drain (e.g., firms that have taken up bank credit, downscaled investment, downscaled costs, etc.). Finally, while the total volume of temporary unemployment payments has typically dampened a cash drain, tax exemptions benefit disproportionately firms that have not seen their liquidity position deteriorated by the crisis. The reason is that preferable tax treatment of investment only accrues to firms that effectively keep investing throughout 2020. These firms have on average a healthy cash balance[1].

In addition, the two other panels of chart 10 investigate whether support was channeled to pre-pandemic productive and profitable firms, respectively. Both panels focus on the subset of firms with a cash deficit without

1 It should be recalled that the carry-back tax system is only expected to lead to liquidity support as of October and falls outside the scope of the time frame considered.

support measures. The middle panel classifies firms in bins of decreasing pre-pandemic labour productivity. The bottom panel categorises firms according to whether they were profitable prior to the pandemic. The pattern in the centre of both panels shows that debt moratoria were used disproportionately more by productive and profitable firms. The 40 % most unproductive firms account for only 15 % of the total debt moratorium volume. Similarly, while we classify 8 % of currently cash-deprived firms as non-profitable before the crisis, they only represent 0.7 % of total volume of State-guaranteed loans. This pattern follows naturally from the eligibility criteria which bar firms with payment arrears (the incidence of which is high among nonprofitable firms). As nuisance/discomfort premia are received irrespective of whether the firm is productive or profitable, they accrue to these firms in proportion to their size in the population. Temporary unemployment, by construction, is received more by the relatively unproductive (measured by labour productivity) firms in each sector.

In sum, State-guaranteed loans and debt moratoria disproportionately amass to firms that need cash due to the COVID-19 crisis. Moreover, the volume of debt moratoria and State-guaranteed loans is asymmetrically provided to profitable and productive firms. Compensation premiums have some leakage to firms that do not need it. It is a brute force policy measure which aims to keep firms afloat, irrespective of the viable nature of the beneficiary. While good arguments exist for such measures (avoid supply chain disruptions, knock-on effects in banks' credit portfolios, slump in demand due to high unemployment), additional conditionality might be warranted.

2.4 The post-policy-intervention problem

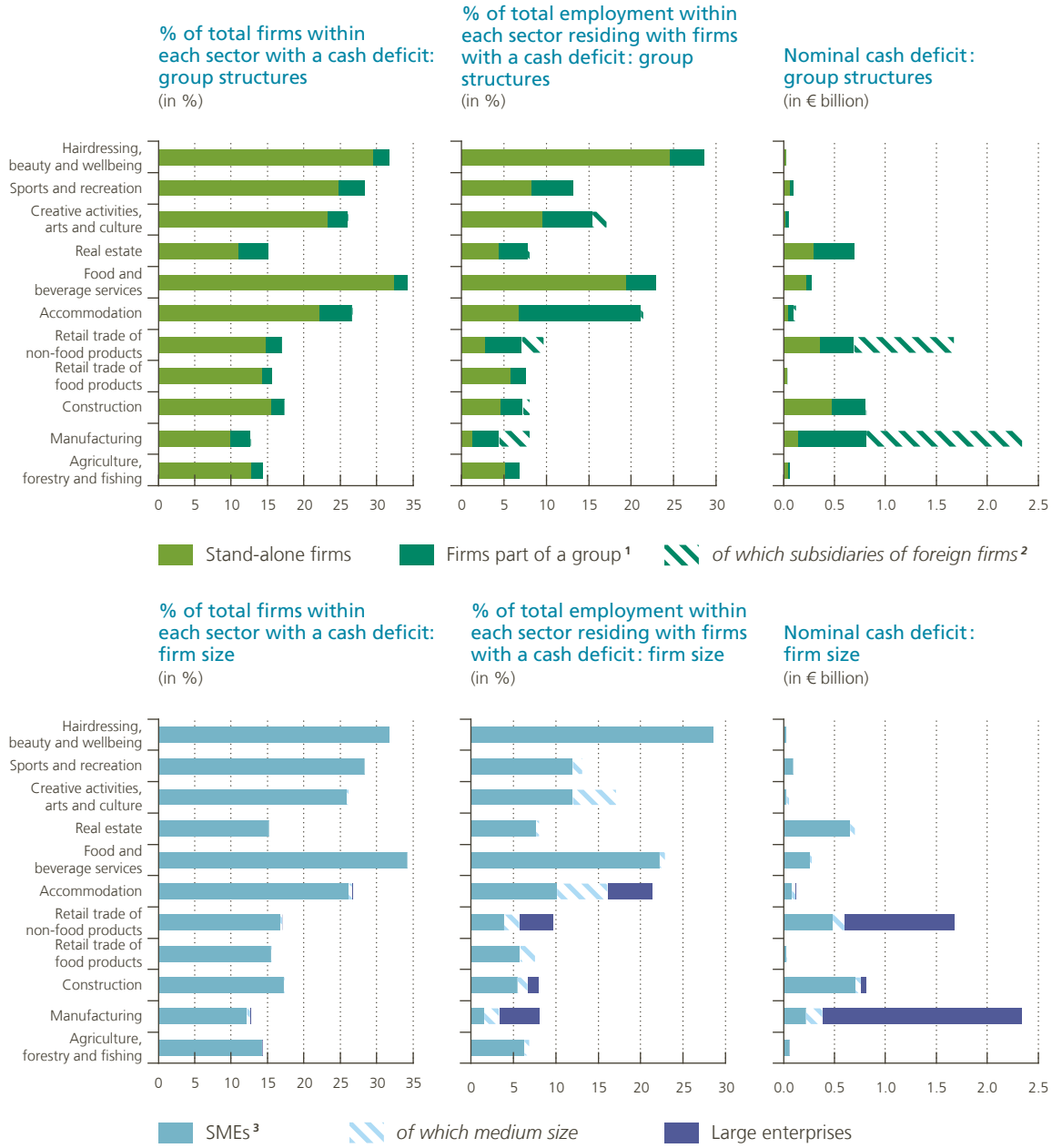
Even with policy measures, acute liquidity problems due to the COVID-19 crisis remain for 15 % of firms. This residual cash shortfall can be addressed through various mechanisms that are not part of our estimation framework. They are discussed below.

First, many corporate groups, in which multiple companies are organised under the management of a controlling parent company, have installed cash pooling systems. Although the individual companies are legally independent, the group as a whole acts as a strategic unit for which mutual financial support and distribution of liquidity among group members is in the interests of all parties involved. In the context of the COVID-19 crisis, intra-group mobilisation of cash through cash pools has the potential to transfer cash surpluses from an entity with ample liquidity to a cash-deprived group-member[1]. Drawing from common liquidity reserves to meet working capital requirements, rather than using bank loans, is typically a common practice among Belgian corporations affiliated to a parent company. In particular, Piette and Zachary (2016) show that there is a high elasticity between the outstanding amount of non-bank loans in the balance sheets of subsidiaries and their working capital requirement, which suggests intensive use of intra-group financing to meet their liquidity needs. The quantitative link between the outstanding amount of their bank loans and their working capital requirement is, by contrast, very weak whereas it is significant for stand-alone firms. In that context, the top panel of chart 11 isolates the share of firms with a cash problem which are part of a group (and highlights the subset of firms that are subsidiaries to a foreign parent). It reveals that the incidence of group structures among cash-constrained firms is very low (only few are foreign-owned subsidiaries). Its incidence is the largest in Accommodation and the smallest in Retail trade of food products. The second graph in the top panel, however, reveals that across sectors, a large part of sectoral employment resides with cash-deprived firms that are part of a group structure. As above, this is most outspoken in Accommodation (15 %), Retail trade of non-food products (7 %), but also Creative activities, arts and recreation (7 %) and Manufacturing (7 %). Importantly, the last panel reveals that the bulk of the nominal cash shortfall in most sectors originates with firms that are part of an (inter)national group. Taken together, there is potentially a large scope for intra-group cash mobilisation in the presence of more liquid firms in each group.

1 On the other hand, a parent-subsidiary relationship entails the risk of one-sided appropriation of liquidity by the parent from its subsidiaries.

Chart 11

Firms running out of cash, employment of firms running out of cash and nominal size of cash deficit



Source: NBB.

1 Identified based on the annex of the annual accounts.

2 Identified based on the NBB Foreign Direct Investment Survey.

3 EU definition.

Chart 11 (continued)

Firms running out of cash, employment of firms running out of cash and nominal size of cash deficit

Source: NBB.

4 Firm buyer/suppliers structure relies on the 2018 vintage of the B2B database. A firm is tagged to have a potential supplier (buyer) problem if more than 10 % of its supplier (buyer) portfolio volume is also estimated to have a cash deficit in September.

Second, the figures at the centre of chart 11 decompose the residual cash problem along small, medium and large firms. The decomposition highlights that only few large and medium-sized firms have cash problems. However, those experiencing a cash shortfall account for a sizeable fraction of sector-wide employment in Creative arts and culture (5 %), Accommodation (11 %) and Manufacturing (6 %). Moreover, as shown by the third graph in the central panel, larger firms are also responsible for the bulk of the nominal cash shortage. A decomposition by size is informative because many relevant firm characteristics correlate with firm size. For instance, medium and large firms on average have significant financial assets they can liquidate in order to meet their cash shortfall. They are also more likely to have access to the bond market, attract outside equity and maintain credit relationships with foreign banks.

Third, for most firms, a significant fraction of working capital is categorised as "accounts receivable" on the assets side of the balance sheet – the money owed by customers downstream in the supply chain. Accounts receivable are, to some extent, matched by "accounts payable" on the liabilities side of the balance sheet – the money owed to upstream suppliers. Trade credit has often proved to be a resilient source of funding during crisis period, including the global financial crisis and the sovereign debt crisis – see Coulibaly *et al.* (2011). The pandemic presents a perfect storm for supply chains as the COVID-19 shock is more synchronised across sectors, with buyers and suppliers being affected simultaneously. In such settings, the scope for inter-firm lending in the form of trade credit to cushion cash problems is likely to be severely diminished. To gauge this, the last panel in chart 11 quantifies the share of firms for which at least 10 % of the supplier (customer) portfolio volume

is flagged to have a cash deficit. The patterns reveal that the scope for more trade credit beyond traditional payment delays is limited given that cash-deprived firms typically have a large fraction of their supplier base with cash problems themselves. These problems are most outspoken in fragile sectors such as the Food and beverage services and Creative activities, arts and culture sectors. Moreover, the final panel reveals that most of the cash shortfall in the manufacturing sector resides with firms with a fragile supplier base. While these results hint at limited use of supplier trade credit to cushion cash problems, they also reveal the risk of cascade failures of firms as trade credit chains are known to act as a vehicle for the propagation of corporate bankruptcies and financial distress (Jacobson & von Schedvin (2015), Tielens & Van Hove (2019)).

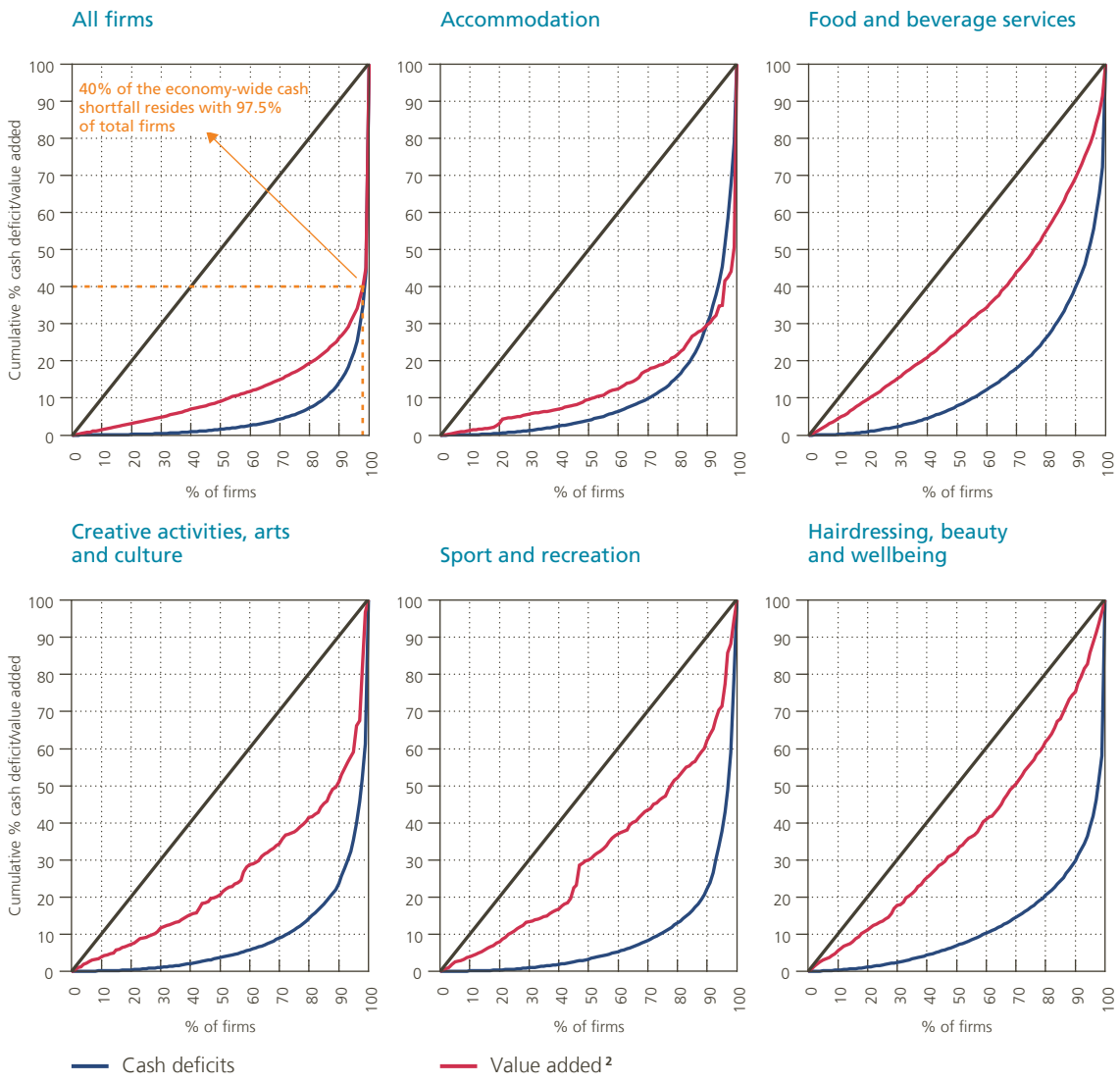
At the end of September, after policy interventions, a total cash deficit of € 15.6 billion remains (on top of € 1.6 billion that would have arisen irrespective of the pandemic). The bulk of this aggregate cash shortfall resides with only a handful of large firms. To quantify this, chart 12 draws Lorenz curves for a selection of sectors and the aggregate economy. While Lorenz curves are typically used to illustrate inequality in society's income/wealth, we use them here to measure how unequal the total cash deficit within each sector is spread across firms. To compute a Lorenz curve, we first order the firms by the magnitude of their cash shortfall, starting with the lowest : and then plot, against the cumulative proportion of the firms so ordered (running from 0 to 1 along the horizontal axis), the cumulative proportion of the sectoral cash shortfall that originates with these firms. If all firms had the same cash deficit, the Lorenz curve would run along the 45-degree line. The deviation from this 45-degree lines highlights that the aggregate cash-shortfall (in blue) is unequally distributed across firms within a sector. E.g. in Creative activities, arts and culture around 70 % of the entities account for 10 % of the total cash shortfall. In Food and beverage services, 40 % of the nominal cash shortfall can be traced to 5 % of individual firms.

The Lorenz curves elicit the message that the total cash shortfall is very concentrated among a small subset of entities in the economy. While this implies that a policy support package – with a size well below the total aggregate sectoral cash shortfall – can directly keep a large number of firms afloat, it sidesteps the observation that the bulk of value added is also distributed asymmetrically among firms with a cash deficit. For instance, while the upper left panel in chart 12 indicates that close to 60 % of the nominal economy-wide cash shortfall resides with only 2.5 % of firms with a cash deficit (blue curve), this small group of firms also produces 60 % of value added (red curve). In various sectors, this asymmetry is less apparent. For example, in Hairdressing and wellbeing around 80 % of firms represent 20 % of that sectors' cash need and account for 60 % of value added in that sector. Similarly, in Sports and recreation, 80 % of firms account for 15 % of that sector's aggregate cash deficit but at the same time represent 50 % of value added. Policy-makers can exploit these asymmetries to set up well-tailored and calibrated programme that maximally support value added and support as many firms as possible at a minimum cost.

Chart 12

Lorenz curves for businesses' cash deficits & value added [1]

(Based on September 2020 estimates of cash deficits)



Source: NBB.

1 The Lorenz curve for cash deficits is a way of showing the distribution of cash requirement within sectors. The Lorenz curve plots the percentage of total cash requirements of firms when firms are ordered by the size of their cash requirement.

2 The value added curves quantify the cumulative percentage of value added (in economy-wide value added) of the group of firms on the horizontal axis.

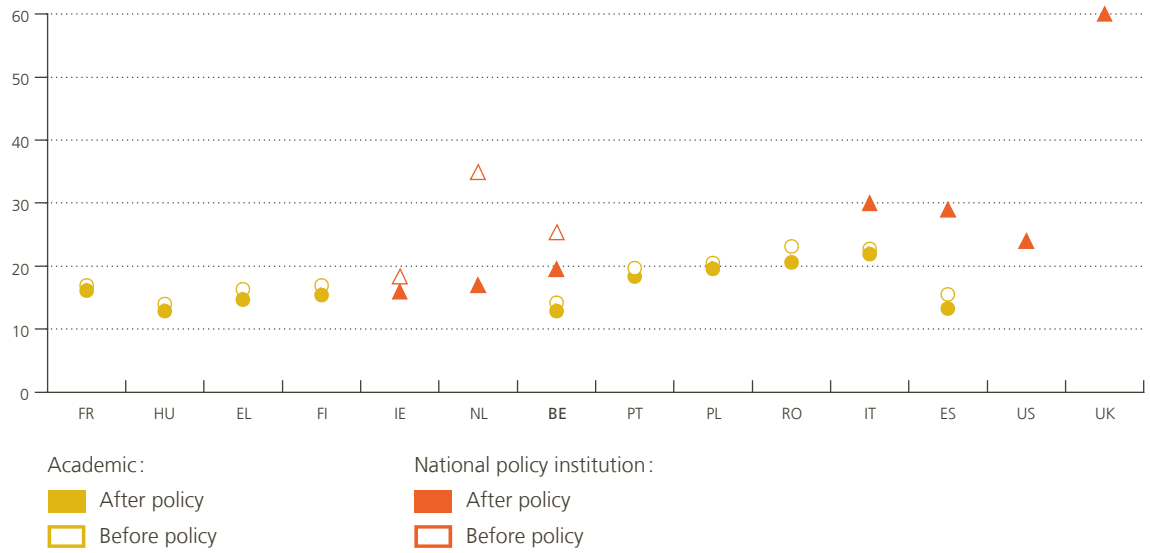
2.5 Cross-country comparison

Since the start of the pandemic, academics, international institutions and the private sector have attempted to estimate the size of businesses' liquidity stress within various countries. While it is appealing to benchmark Belgium with results available for other countries, two caveats render such a comparison intricate. First, the

Chart 13

International comparison of cash requirements

(% of firms with cash requirements before and after policy interventions)



Sources: Academic: Gourinchas *et al*. (2020). Policy institutions: US: Crouzet & Gourio (2020) – Spain: Blanco *et al*. (2020) – Italy: Bank of Italy (2020) – The Netherlands: CPB (2020) – UK: Bank of England (2020) – Ireland: Lambert *et al*. (2020) – Belgium: NBB.

underlying methodology often targets a different liquidity concept[1]. Second, even if these studies offer an estimate of firms' liquidity similar to ours (i.e. a cash deficit), any comparison is typically plagued by the fact that the estimates (a) are developed at different points in time (i.e. the information set on which each study is performed varies), (b) rely on data sources of varying breadth and depth (e.g. exclusively annual accounts data vs. complementary confidential data), (c) have a varying coverage of the corporate sector (e.g. exclusively public firms vs. exclusively SMEs), (d) and rely on different modelling assumptions (e.g. expected duration of the lockdown), etc.

With these caveats in mind, chart 13 positions Belgian liquidity needs with those estimated for other countries. Estimates are taken from a country-wide study by Gourinchas *et al*. (2020) from September 2020 (which, to the best of our knowledge, is currently most exhaustive and detailed in terms of country results). If available, estimates by the relevant national authority (national central bank, statistical agency) are also reported. Taken at face value, the order of magnitude shows that liquidity needs are similar across countries, ranging between 10 % (Hungary) to 22 % (Italy). The share of Belgian cash-constrained businesses closely matches that of neighbouring countries (France, the Netherlands). Note that the figure is uninformative with respect to the impact of support measures (the discrepancy in 'before' and 'after' shares) because the set of policy measures taken on board varies.

1 E.g. shocks on financial ratios (Alstadsæter, *et al.* 2020) or cash buffer days/months which quantifies the number of days/months before the firm runs out of cash (Didier *et al.* (2020), CPB (2020), Renkin (2020)).

3. Solvency problems in the making?

Beyond the liquidity shortfalls discussed in the previous sections, the COVID-19 crisis will undoubtedly have a strong negative impact on many firms' financial health, hampering their future ability to bear their interest charges and amortise the principal. These concerns are discussed in this section. More precisely, we first document the implications of the COVID-19 crisis on firm profitability and quantify the ensuing impact on firm solvency. To that end, we take two routes. The first is to infer firm solvency positions from a (hypothetical) balance sheet at the end of September 2020. The second is to simulate the ability of firms to service additional debt taken out to address their cash deficit. The final sub-section maps the solvency risk to the bank credit portfolios.

3.1 Firm profitability during the COVID-19 crisis

Based on the VAT returns filed between March and September 2020, we estimate that – without support measures – around 26 % of firms incurred losses over that period, in the sense that their earnings before interest payment, taxes, depreciation and amortisation (EBITDA) would be either negative or insufficient to cover their financial charges[1]. This is 8 percentage points more than during the corresponding period in 2019 (note that this number remains mute on the numerous firms that saw their revenue decline while remaining profitable). At the same time, 6 percent of the total firm population became profitable in 2020 after they incurred losses in 2019, which emphasises the fact that, while some sectors and businesses have been severely impacted by the COVID-19 crisis, others continued their development. Additionally, 48 % of total employment resides with firms that incurred losses during March up to September 2020.

Chart 14 furthermore illustrates the impact of the various support measures on firms' profitability. According to our estimates, 2 % of the total number of firms (i.e. approximately 8 000 businesses) became profitable in 2020 due to the combination of tax exemptions, premiums, and an easier recourse to temporary unemployment. These firms account for around 1 % of the total employment of the population of non-financial corporations considered in this exercise.

3.2 Solvency position in September 2020

Measuring the impact of COVID-19 on firms' solvency is a challenging task as it is not straightforward to assess, at the time of writing this article, how firms have addressed their liquidity problems. For instance, as discussed in section 2, some of them might have sold real or financial assets to meet their most immediate liquidity needs, while others could have made an agreement with the landlord of the premises they occupy to reduce or postpone rent payments. Likewise, we do not have indications on the extent to which firms belonging to a Belgian or a multinational group – which account for 69 % of the estimated total amount of liquidity requirement in September 2020 – have tapped cash pooling arrangements with related companies to obtain the funds they need to cope with the crisis.

With this caveat in mind, we assume, as in Crouzet and Gourio (2020), that any cash shortfall in September is addressed by taking out additional debt, for instance a bank credit or a subordinated loan from private or public investors. We then assess firms' solvency based on a hypothetical balance sheet for September (see Annex A for details). Chart 14 documents that such a funding scenario would entail many firms with a debt-to-asset (DTA) ratio exceeding unity. In other words, the amount of their total debt – i.e. their pre-existing debt plus the debt incurred since the onset of the crisis and the hypothetical debt taken out to close the cash deficit – would be larger than the book value of their total assets, which is equivalent to negative equity. This does not necessarily

1 This also does not account for rent payment (not subject to VAT).

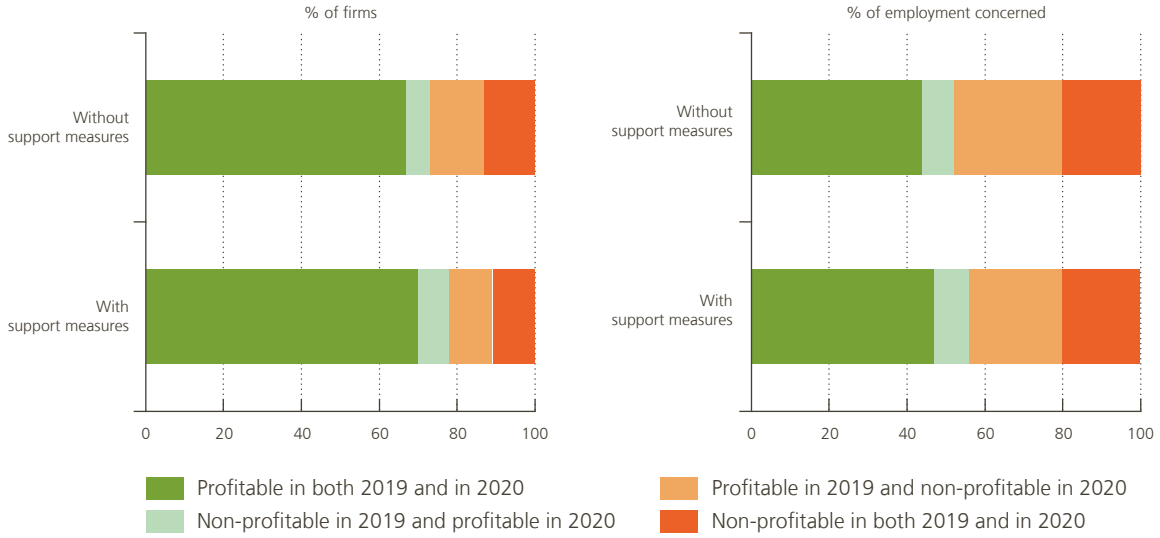
mean that they would all run an immediate bankruptcy risk, insofar as the equity might be replenished with retained earnings at some point in the future, provided that the firms concerned manage to regain their profitability. It nonetheless implies that they would be in fact hardly eligible for the hypothetical additional debt financing we simulate here, since they would not have enough collateral to pledge, making them insolvent in the event of a default.

Chart 14

Impact of the crisis on firms' profitability and solvency

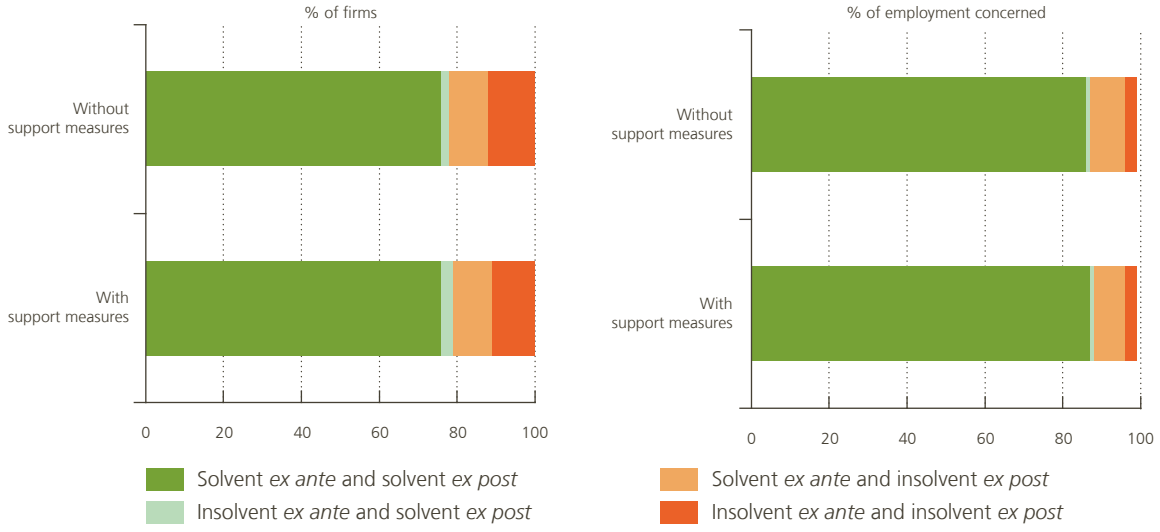
Population of profitable and non-profitable firms in 2019 and in 2020 [1]

(estimates for the period spanning from March to September 2020, and the corresponding period in 2019)



Solvent and insolvent firms before the crisis and in September 2020 [2]

(*ex-ante* values are based on the most recent annual account data; *ex-post* values for September 2020 are projections assuming cash deficits are solved by means of a debt instrument)



Source: NBB.

1 A firm is considered profitable if its interest coverage ratio, i.e. the ratio of the EBITDA over the interest payment, is equal to or larger than 1, and non-profitable if it is lower than 1. If a firm does not report any interest payment in its income statement, then it is considered non-profitable it its EBIDTA is negative

2 A firm is considered solvent if its debt-to-assets ratio is equal or less than 1 and insolvent if it is more than 1.

Quantitatively, our results suggest that the magnitude of this debt overhang problem resulting from the COVID-19 crisis would be sizeable: 21 % of firms would end up with a DTA ratio higher than 1 under the assumption of debt financing of their liquidity requirement at the end of September 2020. This is 7 percentage points more than the *ex-ante* situation such as reflected in the most recent annual account data. Moreover, this impact is barely alleviated by the support measures, which were devised to patch up firm liquidity without the goal of addressing solvency. Even before the onset of the COVID-19 crisis, most firms recording structural losses (i.e. firms with structurally negative earnings[1] or earnings that persistently do not cover their financial charges) are characterised by a DTA ratio larger than 1 (i.e. their equity has been entirely consumed by accumulated losses). However, one significant consequence of the crisis is that even businesses that used to be profitable in the previous years and require a large amount of additional financing to offset their liquidity shortfall, would become insolvent. In fact, only a relatively limited part of the firms projected to lack the liquidities needed to meet their regular payments in September 2020 – around 6 600 out of 79 000 – may be considered non-profitable and therefore not able to sustain additional debt.

The fact that a liquidity shortfall might turn into a solvency problem for numerous profitable and, by extension, viable firms is clearly a major economic policy issue. Indeed, in addition to the immediate rise in unemployment and the defaults on trade and bank credits they might cause, bankruptcies of otherwise healthy businesses would also harm the productive fabric of the economy and, ultimately, its potential growth and job creation.

3.3 Is additional debt sustainable?

In this sub-section we investigate whether the hypothetical loan from the previous sub-section would be sustainable (i.e. whether the firm is able to service monthly interest payments and repay the principal when it comes due) and, if so, what the minimum term of that loan should be. Irrespective of its solvency position in September 2020, the idea is that a firm would need a certain amount of time to generate the cash flows required to bear the interest charges and repay the loan at maturity. Of course, determining this maturity at the firm level involves a certain number of assumptions, most importantly with respect to the future evolution of its cash flows. More specifically, we assume that the sales recovery path is analogous to the latest GDP forecasts after September 2020. We also assume that any additional debt would in any case not be sustainable for firms active for at least five years and having recorded losses over the past three accounting years. Other methodological details related to this simulation are given in the last part of Annex A.

The results of these simulations are reported in chart 15. They suggest that a short-term loan, i.e. a loan with a maturity of up to one year, would be enough to ensure the survival of a large proportion of (profitable) firms that are expected to have run out of cash in September 2020. Nonetheless, 59 % of them, which account for 64 % of the total liquidity need, would require funding with a maturity longer than one year in order to absorb the shock of the crisis. A similar pattern emerges if only stand-alone firms are taken into consideration. Moreover, many firms in this group have experienced a deterioration of their financial health due to the crisis, and their DTA ratio will exceed 1 if they take out a loan to replenish their cash reserves. As already mentioned above, this weakened solvency might make it difficult for them to obtain such a loan from a credit institution, even though their level of profitability, such as observed from their last income statements, might suggest their ability to generate a sufficient amount of cash flows to service their debt.

1 We measure firms' earnings based on earnings before interest, taxes, depreciation and amortisation (EBITDA).

Chart 15

Sustainability of a hypothetic new debt taken out to solve the cash deficits estimated for September 2020

Source: NBB.

1 Stand-alone firms are corporations that are not related to a Belgian or a multinational group.

2 The evaluation of whether a loan with a certain maturity is sustainable for a given firm is based on the assumption that the growth of its sales follows the same recovery path until the fourth quarter of 2023 as that of GDP, such as forecast in the December 2020 macroeconomic projections. Beyond that horizon, convergence towards a long-run steady-state growth is imposed at the sector level. The dynamics of the support measures reflect the information currently cast and approved in legislation. The loan is assumed to be unsustainable for non-profitable firms.

3 A firm is considered insolvent if its debt-to-assets ratio is larger than 1.

3.4 Banks: prudent lenders of first resort

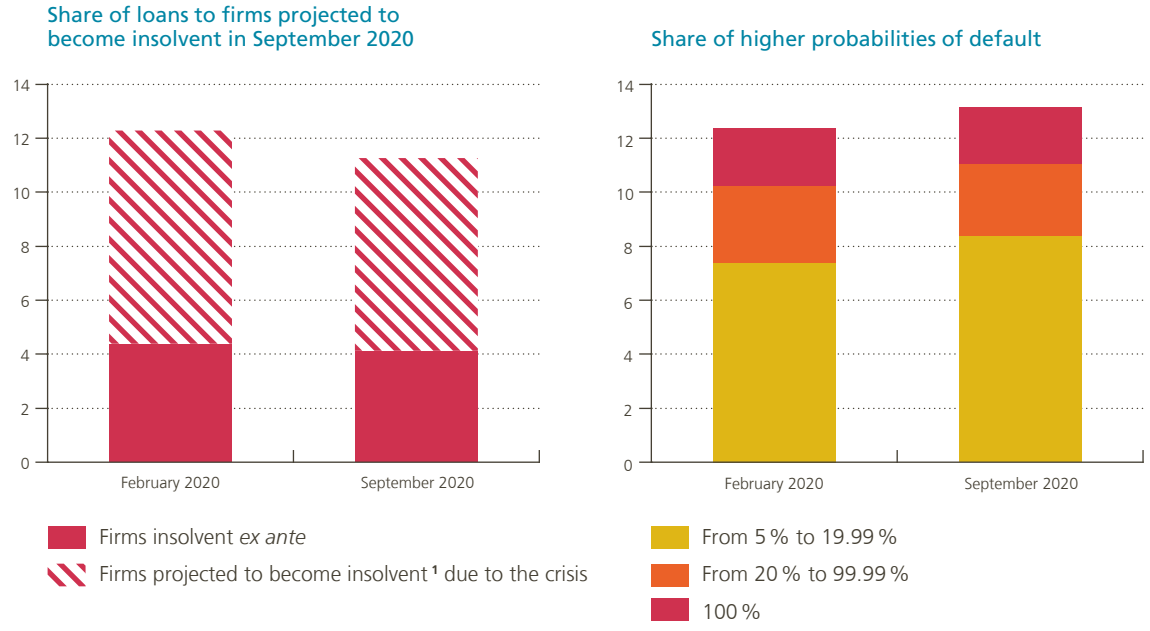
The data from the Central Corporate Credit Register corroborate the difficult access to bank finance by firms likely to be rendered insolvent due to the crisis. The share of these firms in the total outstanding amount of loans granted by Belgian banks to non-financial corporations has declined slightly during the first wave of the pandemic, from 7.9 % in February 2020 to 7.1 % in September (see chart 16). Hence, while banks have been important in keeping many firms afloat by providing the cash needed during the first wave of the pandemic, they seem to have contained the share of those characterised by negative equity in their credit portfolio. This apparent conservatism is not surprising as credit institutions are subject to prudential rules designed to mitigate the risk entailed by poorly collateralised loans and associated with a high probability of default. Moreover, firms considered as "undertakings in difficulty", according to the definition set by the EU that includes a threshold on accumulated losses, are explicitly excluded from the second State-guarantee scheme adopted in July 2020. Of course, firms whose equity has turned negative due to accumulated losses (and whose DTA ratio is therefore larger than 1) are *a fortiori* undertakings in difficulty within the meaning of the EU definition.

Overall, the riskiness of Belgian banks' corporate loans did not appear to have risen significantly during the first wave of the pandemic. Chart 16 documents that the share of riskiest loans, i.e. those with a probability of default higher than 5 % rose barely from 12 % to 13 % between February and September 2020, which points to a recent, but very moderate, rise in credit risk. Furthermore, the share of high-risk loans (with probability of default equal to 20 % of more) and non-performing loans (to which a probability of default of 100 % is assigned) has remained stable over that period.

Chart 16

Share of riskier loans in Belgian banks' corporate credit portfolio

(% of total used credits)



Source: NBB.

1 A firm is considered insolvent if its debt-to-asset ratio is larger than 1.

Conclusion

The COVID-19 crisis has taken its toll on the Belgian corporate sector. A sudden drop in revenues and imperfect downscaling of costs has put considerable pressure on firms' cash buffers. In order to alleviate liquidity concerns, Belgian policy-makers have acted swiftly to support the corporate sector and stepped up efforts as the pandemic unfolded.

In this article, we document the pockets of corporate liquidity and solvency risk and examine the role of various policy measures taken to keep businesses afloat. We show that the support measures taken have successfully dampened cash outflows of firms. Temporary unemployment alleviated liquidity stress across the board. Nuisance/compensation premia mostly relieved liquidity concerns of small firms whereas initiatives involving the financial sector (mainly debt moratoria) principally supported larger firms. While the support measures successfully patched up liquidity concerns in the short run, part of this aid has leaked to firms that strictly did not need support or did not run viable business operations prior to the pandemic. In parallel to government-coordinated policy measures, the private banking sector is shown to have acted to some extent as a (prudent) lender of first resort. Despite these observations, approximately one out of six non-financial firms are estimated to remain with pressing cash deficits attributable to the pandemic prior to the start of the second wave. These firms had to resort to payment extensions and/or additional non-bank funding (e.g. through intra-group mobilisation of funds through cash pooling).

Our analysis documents a non-trivial rise in solvency risk. Losses caused by the COVID-19 crisis have severely eroded many firms' equity in the most affected sectors, and replenishing their cash reserves would involve a substantial rise in their indebtedness in the absence of alternative financing sources. Importantly, even profitable firms with a solid balance sheet prior to the pandemic are not immune to this concern and might spiral into bankruptcy should they not obtain additional financing. It is therefore very likely that a large share of Belgian firms will start the recovery period with deleveraging pressures, which can have negative consequences on these companies' ability to carry out investment plans, dragging down productivity and growth. In this context, and in the face of the second wave of the pandemic, the policy focus should gradually shift from safeguarding firms' liquidity to maintaining their solvency. The purpose should be to secure debt restructuring where it is appropriate and/or access to any external long-term financing they might need for the continuation of their operations, as well as for their future development.

Furthermore, to effectively accompany the recovery phase, current policies in place to ease access to credit should be matched with enhanced instruments for (long-term) equity-type financing. However, in the Belgian context, it is not straightforward to find effective equity instruments, especially for SMEs whose owners are often reluctant to allow external ownership. Alternative financing vehicles and instruments such as long-term subordinated loans can be considered for strengthening viable firms' solvency and enabling them to invest and grow further. In that regard, the initiatives recently taken by Regional governments to increase the lending capacity of their investment vehicles are a first step in that direction. Moreover, in order to stimulate equity investment, the current notional interest deduction framework could be revisited.

Finally, from an economic policy point of view, there is scope for a more discretionary approach to ensure an effective use of the public funds intended to support businesses: on the one hand, in order to avoid allocating real and financial resources to non-viable firms – a phenomenon known as "zombification" – and, on the other hand, to support viable businesses that would not be able to obtain the funds they require from other financing channels, such as traditional bank lending, due to a potential debt overhang. Support could also be tailored in such a way that it is larger for firms injecting additional capital and firms that have business plans anchored to the "new normal". Such "smart conditionality" – linking support to steps that enhance firms' longer-term resilience, like digitalisation or the adoption of new business processes – can be a way to preserve activity while strengthening firms' perspectives going forward.

Annex A: Analytical framework

This annex sketches the main ingredients of the liquidity and solvency analysis. The framework parallels other policy work (OECD (2020), European Commission (2020a,b), Bank of Italy (2020), Centraal Planbureau (2020)) and is related to a set of academic contributions (De Vito & Gomez (2020), Schivardi & Romano (2020), Mirza *et al.* (2020), Carletti *et al*. (2020)). We improve on these existing frameworks in view of (i) the rich and timely nature of the available Belgian data and (ii) the specific Belgian context (e.g. support measures, Belgian accounting templates, etc.). For the sake of tractability, we focus on the conceptual nature of the framework and sidestep many operationalisation details. The data used for calibration/estimation of the framework are detailed in Annex B. Annex C gauges the impact of the most important modelling assumptions.

A.1 Liquidity

At the core of the liquidity analysis is the following firm-level dynamic equation (where the firm identifier is implicitly understood and subscript m refers to the end of a particular month):

$$\begin{aligned} & Cash\,balance_{m-1} \\ & + Normal\,cash\,flows_m \\ & + Abnormal\,cash\,flows_m \\ & + Support\,measures_m \\ & = Cash\,balance_m \end{aligned} \tag{1}$$

This equation iteratively produces the cash balance available at the end of the month, starting from a cash position at the end of the previous month and accounting for three types of net cash flows that accrue throughout the month. First, $Normal\,cash\,flows_m$ are monthly net cash flows that materialise in normal (non-crisis) times. Second, $Abnormal\,cash\,flows_m$ are monthly net cash flows that arise in the context of an unexpected shock (*in casu*, the COVID-19 crisis). Third, $Support\,measures_m$ are net cash flows obtained by the firm through various policy interventions. If the cash balance turns negative at the end of the month, the firm is flagged to have a cash requirement. Formally,

$$Cash\,requirement_m = -Min\{0, Cash\,balance_m\} \tag{2}$$

Equations (1) and (2) have a few interesting features. First, a firm can structurally burn cash (as would be captured by a negative $Normal\,cash\,flows_m$) and therefore might start to signal a cash crunch irrespective of the COVID-19 crisis. Second, a firm can be severely affected by the crisis (i.e. feature a large negative $Abnormal\,cash\,flows_m$) but would not show liquidity strains if it had started out from a comfortable initial cash position. Third, a cash requirement points to a shortage of sufficient cash, but a firm might also have a fragile liquidity position despite not having a formal cash requirement in equation (2). Fourth, by including the term $Abnormal\,cash\,flows_m$, we can isolate the marginal impact of the COVID-19 crisis which is not confounded with liquidity concerns that would arise for some firms in 2020 without the occurrence of the crisis.

The analysis starts with an initial amount of cash held by firms at the end of February 2020 (the start of the crisis in Belgium – see sub-section 1.1). For that purpose, we make the reasonable assumption that the last available annual accounts data (for most firms, 31 December 2019) reflects the financial situation at the end of February 2020. The remaining challenge of the framework is to estimate/infer the three net cash flow entries in equation (1). Below, we discuss their measurement.

Normal cash flows

Conceptually, the purpose is to quantify the monthly normal cash flows that would have accrued in 2020. The qualification "normal" implies that these cash flows would have reasonably materialised had the COVID-19 outbreak not occurred. By and large, they are a mapping of historical cash flows (2019 and earlier) to 2020. In view of this objective, we decompose $Normal\,cash\,flows_m$ as follows:

$$\begin{aligned} Normal\,cash\,flows_m &= Sales_m \\ &- Inputs_m \\ &- Wages_m \\ &+ Financial\,revenues_m \\ &- Interest\,payments_m \\ &- Current\,taxes_m \\ &+ Deferred\,taxes_m \\ &- \Delta Working\,capital\,requirement_m \\ &- Investment_m \\ &+ \Delta Debt_m \end{aligned} \tag{3}$$

where $Sales_m$ reflects turnover from normal business operations (selling of goods and services) and $Inputs_m$ captures an array of various cash outflows (procurement of intermediates, services, commodities, etc.). $Wages_m$ is set to capture the monthly wage bill, including social security contributions. $Financial\,revenues_m$ encompasses financial revenues (e.g. interest accruing from a bank account or dividends paid to a parent company by its affiliates). $Interest\,payments_m$ denotes interest payments on debt. The change in working capital requirement corresponds to the difference between the changes in current assets and current liabilities (i.e. $\Delta Working\,capital\,requirement_m = \Delta Current\,assets_m - \Delta Current\,liabilities_m$) and accounts, among other things, for deferred payments and receivables. $Current\,taxes_m$ reflects current taxes due whereas $Deferred\,taxes_m$ captures taxes due but which have not yet been paid. The former is defined as

$$\begin{aligned} Current\,taxes_m = (&Sales_m - Inputs_m - Wages_m + Financial\,revenues_m - Interest\,payments_m \\ &- Depreciation_m) \times \tau \end{aligned} \tag{4}$$

with τ as the applicable corporate income tax (CIT) rate and CITs are paid only when earnings are positive [1]. While the aforementioned summands in equation (3) are subject to forces that typically fall outside the discretion of the firm (e.g. drop in demand, disrupted supply, distorted production capacities due to social distancing/telework, etc.), cash accumulation is also partly determined by its investment expenditures ($Investment_m$) and the changes in its outstanding bank debt $\Delta Debt_m$, which to a larger extent reflect autonomous strategic decisions by the firm.

Abnormal cash flows

The notion of "abnormality" refers to an unexpected or abnormal change in sales in month t ($\partial Sales_t$), which perturbs the various components of firms' $Normal\,cash\,flows_m$ in month m (with $t \leq m$) [2]. Hence, to construct $Abnormal\,cash\,flows_m$, we first take the first derivative of (3) with respect to $Sales_m$, which yields the following contemporaneous (i.e. $t = m$) expression:

1 Different CIT rates apply for large and smaller firms.

2 In the theoretical development of the framework, we take an exclusively backward-looking perspective, i.e. expectations of future shocks do not drive current decisions (e.g. a decline in investment). Nonetheless, when we bring the framework to the data, such forward-looking behaviour enters the measurement of some of the cash flows already observed.

$$\frac{\partial Normal\,cash flows_m}{\partial Sales_m} = 1 - \frac{\partial Inputs_m}{\partial Sales_m} - \frac{\partial Wages_m}{\partial Sales_m} + \frac{\partial Financial\,revenues_m}{\partial Sales_m} - \frac{\partial Interest\,payments_m}{\partial Sales_m} - \frac{\partial Current\,taxes_m}{\partial Sales_m} + \frac{\partial Deferred\,taxes_m}{\partial Sales_m} - \frac{\partial \Delta Working\,capital\,requirement_m}{\partial Sales_m} - \frac{\partial Investment_m}{\partial Sales_m} + \frac{\partial \Delta\,Debt_m}{\partial Sales_m} \quad (5)$$

The left-hand side expression in (5) denotes the change in $Normal\,cash flows_m$ in month m (expressed in euro) for a one euro abnormal change in $Sales_m$ in month m. On the right-hand side, we make a few assumptions going forward. First, we assume that $\partial \text{Wages}_m / \partial Sales_m = 0$, implying that firms cannot hire/fire labour in the short run. Such an approach seems reasonable in view of the limited time frame of our analysis. As detailed below, lower wage outlays through temporary unemployment enters the analysis via support measures ($Support\,measures_m$ in equation (1)). Second, in a similar vein, $\partial \Delta\,Debt_m / \partial Sales_m$ is stripped from the amounts pertaining to the debt moratorium and State guarantees. Finally, deferred taxes do not change with respect to the current shock ($\partial \text{Deferred taxes}_m / \partial Sales_m = 0$).

Apart from contemporaneous effects in equation (5), one needs to account for changes in future cash flows that arise from a sales shock in the current period. First, todays' variation in investment in equation (5) leads to a change in the size of future fixed-asset depreciation (which impacts future taxes and therefore future cash flows). Second, a change in debt in equation (5) causes a change in future interest charges. This dynamic implication of an unexpected shock to sales in month t on future cash flows in month m $(m > t)$ is given by the differential

$$\frac{\partial Normal\,cash flows_m}{\partial Sales_t} = -\frac{\partial Current\,taxes_m}{\partial Sales_t} - \frac{\partial Interest\,payments_m}{\partial Sales_t} = \frac{\partial Investment_t}{\partial Sales_t} \times \delta \times \tau - \frac{\partial Interest\,payments_t}{\partial Sales_t}(1-\tau) \quad (6)$$

where δ is the depreciation rate of fixed assets and is assumed to be constant. Subsequently, adding the derivatives in equations (5) and (6) yields (compactly):

$$Abnormal\,cash flows_m \overset{\text{def}}{=} \sum_{t=1}^{m} \frac{\partial Normal\,cash flows_m}{\partial Sales_t} \times \partial Sales_t \quad (7)$$

Or, more elaborate (after rearranging):

$$
\begin{aligned}
Abnormal\,cash\,flows_m = {} & \partial Sales_m \\
& - \frac{\partial Sales_m}{Sales_m} \times \varepsilon_{in} \times Inputs_m \\
& - \frac{\partial Sales_m}{Sales_m} \times \varepsilon_{ct} \times Current\,taxes_m \\
& - \frac{\partial Sales_m}{Sales_m} \times \varepsilon_{ip} \times Interest\,payments_m \\
& + \frac{\partial Sales_m}{Sales_m} \times \varepsilon_{fr} \times Financial\,revenues_m \\
& - \frac{\partial Sales_m}{Sales_m} \times (\varepsilon_{\Delta ca} \times \Delta Current\,assets_m - \varepsilon_{\Delta cl} \times \Delta\, Current\,liabilities_m) \\
& - \frac{\partial Sales_m}{Sales_m} \times \varepsilon_i \times Investment_m \\
& + \frac{\partial Sales_m}{Sales_m} \times \varepsilon_{\Delta dbt} \times \Delta\, Debt_m \\
& - \sum_{t=1}^{m-1} \frac{\partial Sales_t}{Sales_t} \times \varepsilon_{ip} \times Interest\,payments_t \times (1-\tau) \\
& + \sum_{t=1}^{m-1} \frac{\partial Sales_t}{Sales_t} \times \varepsilon_i \times Investment_t \times \delta \times \tau
\end{aligned}
\qquad (8)
$$

Equation (5)

Equation (6)

where the left-hand side captures the change in cash flows in month m, expressed in euro, due to abnormal shocks to sales in all months running up to (and including) month m. The scalar ε is the elasticity of the subscripted variable with respect to $Sales_m$ (e.g. ε_{in} quantifies the percentage change in $Inputs_m$ for a 1 % shock to $Sales_m$).[1] It is instructive to reflect on equation (8).

First, if (a) all the firm's operating costs were fixed ($\varepsilon_{in} = 0$), (b) changes in financial revenues, interest payments and working capital were fully independent from sales ($\varepsilon_{fr} = \varepsilon_{ip} = \varepsilon_{\Delta cl} = \varepsilon_{\Delta ca} = 0$) and (c) the shock to sales did not prompt any change in the firms' investment or borrowing decision ($\varepsilon_i = \varepsilon_{\Delta dbt} = 0$), then the cash flows before taxes would decrease by the same amount as the decrease in sales. However, if the firm can scale down its production, reduce its operating costs, decrease its working capital requirement and modify its investment strategy when sales decrease, it can partially offset outgoing cash flows. In sum, the elasticities measure the degree of a firm's flexibility to adjust to an adverse shock.

Second, in order to quantify equation (8), one can take two routes. The first one is to estimate the elasticities, impose a sales shock and multiply it by the historical (i.e. last observed) value of each cash flow element. The second approach is to acknowledge that each summand essentially reflects the abnormal nominal change in each cash flow in month m. If the data are available in a timely manner, one directly observes the summands, sidestepping the need to infer them. Hence, if possible, preference is given to the second approach (discussed in Annex B). Nonetheless, when we simulate the equation beyond the last observable data point (as is done in section 3), we rely on the specification delineated above.

1 In general, an elasticity is defined as $(\partial x/x)/(\partial y/y) \approx (\Delta x/x)/(\Delta y/y)$. See Varian (2014) for a textbook treatment.

Support measures

We consider a set of broad-based support measures that aim to improve firm-level liquidity/solvency. Let $Support\,measures_m$ be defined as follows,

$$\begin{aligned} Support\,measures_m = {} & Credit\,moratorium_m \\ & + State\,guarantee_m \\ & + Tax\,policy\,exemptions_m \\ & + Nuisance/compensation\,premia_m \\ & + Temporary\,unemployment_m \end{aligned} \tag{9}$$

where $Credit\,moratorium_m$ captures a loan repayment delay (i.e. an otherwise outgoing cash flow had the loan not been under moratorium). $State\,guarantee_m$ reflects new loans and credit lines granted under the State guarantee. $Tax\,policy\,exemptions_m$ encompass a non-exhaustive set of tax exemptions (such as the one-off carry-back regime, the exemption of the withholding tax and the additional investment deductibility). $Nuisance/compensation\,premia_m$ and $Temporary\,unemployment_m$ capture cash flows granted in the context of forced closure (or material sales declines) and temporarily idle personnel, respectively. While the policy details are discussed in the body of the text, additional information on their operationalisation is included in Annex B.

A.2 Solvency

Our assessment of firms' potential solvency issues is based on a hypothetical snapshot of their balance sheet at the end of month M (*in casu* $M = 7$, September 2020, i.e. seven months after the initial activity shock in March). For that purpose, we derive the end of period M entries of an aggregated balance sheet and simplified profit and loss statement. Their calculation – as well as some of the underlying assumptions – are detailed below.

First, iterating on equation (1) yields

$$\begin{aligned} Cash\,balance_M = {} & Cash\,balance_0 \\ & + \sum_{m=1}^{M} (Normal\,cash\,flows_m + Abnormal\,cash\,flows_m + Support\,measures_m) \end{aligned} \tag{10}$$

where subscript 0 stands for the value before the shock (February 2020). Formally, combing eq. (3), eq. (8) and eq. (10) delivers

$$
\begin{aligned}
Cash\,balance_M = Cash\,balance_0 \\
&+ \sum_{m=1}^{M} EBITDA_m && + \sum_{m=1}^{M} \partial EBITDA_m \\
&- \sum_{m=1}^{M} Interest\,payment_m && - \sum_{m=1}^{M} dInterest\,payment_m \\
&- \sum_{m=1}^{M} Current\,taxes_m && - \sum_{m=1}^{M} dCurrent\,taxes_m \\
&- \sum_{m=1}^{M} \Delta\, Working\,capital\,requirement_m && - \sum_{m=1}^{M} \partial\,\Delta\, Working\,capital\,requirement_m \\
&- \sum_{m=1}^{M} Investment_m && - \sum_{m=1}^{M} \partial Investment_m \\
&+ \sum_{m=1}^{M} \Delta\, Debt_m && + \sum_{m=1}^{M} \partial\,\Delta\, Debt_m \\
&+ \sum_{m=1}^{M} Support\,measures_m && + Loan_M
\end{aligned}
\tag{11}
$$

where $EBITDA_m \left(= Sales_m - Inputs_m - Wages_m + Financial\,revenues_m \right)$ stands for the earnings before interest, taxes, depreciation and amortisation. If $Cash\,balance_M < 0$, additional funding is needed to close the cash deficit which exists at time M. We assume this additional funding takes the form of bank debt, denoted $Loan_M$, with maturity T. The interest on $Loan_M$ are paid each month and determined by fixed rate, i, and the principal will be repaid in one lump-sum at the maturity $M + T$. The various terms of equation (11) affect other items of the balance sheet as well. Provided that the earnings resulting from the cash flows accumulated over the period considered are not distributed to shareholders, and also taking into account that capital depreciation is deducted from profits, the first term in equation (11) corresponds to the increase or decrease in equity that takes place through the retained earnings:

$$
\begin{aligned}
Equity_M = Equity_0 \\
&+ \sum_{m=1}^{M} EBITDA_m && + \sum_{m=1}^{M} \partial EBITDA_m \\
&- \sum_{m=1}^{M} Interest\,payment_m && - \sum_{m=1}^{M} dInterest\,payment_m \\
&- \sum_{m=1}^{M} Current\,taxes_m && - \sum_{m=1}^{M} dCurrent\,taxes_m \\
&- \sum_{m=1}^{M} Depreciation_m && - \sum_{m=1}^{M} \partial Depreciation_m \\
&+ \sum_{m=1}^{M} Support\,measures_m && - \sum_{m=1}^{M} State\,guarantee_m \\
&- \sum_{m=1}^{M} Moratorium_m
\end{aligned}
\tag{12}
$$

The projected values for the current assets and liabilities are, respectively[1]

$$Current\,assets_M = Current\,assets_0 + \sum_{m=1}^{M} \Delta Current\,assets_m + \sum_{m=1}^{M} \mathbf{I}\left(\partial\Delta Working\,capital\,requirement_m > 0\right)\partial\Delta Working\,capital\,requirement_m \quad (13)$$

and

$$Current\,liabilities_M = Current\,liabilities_0 + \sum_{m=1}^{M} \Delta Current\,liabilities_m - \sum_{m=1}^{M} \mathbf{I}\left(\partial\Delta Working\,capital\,requirement_m < 0\right)\partial\Delta Working\,capital\,requirement_m \quad (14)$$

where $\Delta Current\,assets_m$ and $\Delta Current\,liabilities_m$ denote the monthly changes in current assets and liabilities in normal times. They are unobserved and assumed to be equal. $\mathbf{I}(.)$ is an operator equal to 1 if the condition between parentheses is true and to 0 otherwise. Equations (13) and (14) are formulated this way to avoid negative outstanding amounts.

The bank loans under moratorium are treated as an additional debt, and the outstanding amount of debt at the end of month M is therefore:

$$Debt_M = Debt_0 + \sum_{m=1}^{M} (\Delta Debt_m + \partial\Delta Debt_m + Moratorium_m + State\,guarantee_m) + Loan_M \quad (15)$$

Finally, the stock of non-financial fixed assets is determined by both investment and depreciation:

$$Non\text{-}financial\,fixed\,assets_M = Non\text{-}financial\,fixed\,assets_0 + \sum_{m=1}^{M} \left(Investment_m - Depreciation_m\right) \quad (16)$$

As mentioned above, $Depreciation_m$ is based on a constant depreciation rate, δ, such that $Depreciation_m = \delta Non\text{-}financial\,fixed\,assets_{m-1}$. Financial fixed assets are assumed to remain constant over the projection period. Finally, using (11)-(16), one can show that assets and liabilities balance:

$$Non\text{-}financial\,fixed\,assets_M + Financial\,fixed\,assets_M + Current\,assets_M + Cash\,balance_M = Equity_M + Debt_M + Current\,liabilities_M$$

The projections for the main balance sheet items at the end of month M provide the input needed to compute the debt to assets ratio after the activity shock caused by the pandemic,

$$Debt\text{-}to\text{-}assets\,ratio_M = \frac{Debt_M + Current\,liabilities_M}{Non\text{-}financial\,fixed\,assets_M + Financial\,fixed\,assets_M + Current\,assets_M + Cash\,balance_M}$$

The firm is qualified as insolvent if the value of this ratio exceeds 1. Moreover, note that $Loan_M$, i.e. the additional funding needed to close the cash deficit, at time M, could cause a debt sustainability issue if the firm is unable to generate enough cash flows to service that debt. In order to assess the proportion of these

1 In our simulations, the changes in working capital requirement is entirely attributable to the shock, which means that the 'normal' change that would be observed without the shock is equal to zero ($\Delta Working\,capital\,requirement_m = 0$).

potentially insolvent firms, we project $Cash\,balance_m$ up to time $T+M$ in order to see whether it suffices to repay $Loan_M$ when it comes due. This projection can be written as[1]

$$Cash\,balance_{M+T} = \sum_{m=M}^{M+T} (\overbrace{Normal\,cash\,flows_m}^{Eq.\ (3)} + \overbrace{Abnormal\,cash\,flows_m}^{Eq.\ (8)} + \overbrace{Support\,measures_m}^{Eq.\ (9)} - i \times Loan_M) \qquad (17)$$

The additional debt is considered unstainable if $Cash\,balance_{M+T} < Loan_M$, i.e. if the cash flows generated by its activity between M and $M+T$ exceed the reimbursement of the principal when due at time $M+T$.

1 In the absence of observed data beyond M, a few additional assumptions are required. First, with respect to $Support\,measures_m$, we account for the dynamics of support measures currently known to us (subject to change in the face of the second wave). Second, as regards $Abnormal\,cash\,flows_m$, we by and large rely on eq. (17), which is determined entirely by a projected path of sales growth. To that end, we impose the GDP recovery path as projected by the December 2020 NBB BMPE (broad macroeconomic projection exercise) on firm-level sales growth.

Annex B: Data and variable measurement

This section describes how we quantify the summands of the equations in our framework. To that end, we join a large set of publicly available and confidential data sources.

Table B.1

Equation	Summand	Measurement / Source
(3)	$Financial revenues_m$; $Interest payments_m$; $Current taxes_m$; $Deferred taxes_m$; $Wages_m$; $\Delta Current liabilities_m$; $Current assets_m$	Taken from the annual accounts.
(3)	$\Delta Debt_m$	Taken from the central Central Corporate Credit.
(3)	$Sales_m$; $Inputs_m$; $Investment_m$	Taken from the annual accounts. Most firms are not required to report $Sales_m$, $Inputs_m$, $Investment_m$. For these firms we rely on confidential VAT filings to impute missing values.

We assume that the last observable annual cash flow is representative for the annual cash flow in 2020 (results are similar when using alternative projection methods). However, provided that most of the entries in (3) are reported on an annual basis, we need to map the annual flow to the monthly frequency. To that end, we impose monthly seasonality factors obtained by monthly VAT returns. Such seasonality corrections are instrumental. They account for the fact that the business volumes of many firms are not equally spread over the year, but biased towards particular periods (e.g. the airline sector during the summer, retail during the regulated sales season in January/July, indoor playgrounds during the Winter/Autumn, etc.).

Table B.2

Equation	Summand	Measurement / Source
(8)	$Sales_m + \partial Sales_m$ $Inputs_m + \frac{\partial Sales_m}{Sales_m} \times \varepsilon_{in} \times Inputs_m = Inputs_m + \partial Inputs_m$ $Investment_m + \frac{\partial Sales_m}{Sales_m} \times \varepsilon_i \times Investment_m =$ $Investment_m + \partial Investment_m$	Directly observed from monthly confidential firm-level VAT data running up to September 2020. Importantly, observing $Inputs_m + \partial Inputs_m$ implies that we do not need to take a stand on which costs are fixed and which are variable, a non-trivial issue in the Belgian annual accounts (Abraham *et al.*, 2020). Observing $Investment_m + \partial Investment_m$ implies that we observe the (mostly) downscaling of investment decisions. $\partial Sales_m$, $\partial Inputs_m$ and $\partial Investment_m$ are inferred by subtracting the values from table B.1.
(8)	$\frac{\partial Sales_m}{Sales_m}$	Directly observed from firm-level confidential VAT data.
(8)	$\varepsilon_{\Delta ca}; \varepsilon_{\Delta cl}; \varepsilon_{\text{fr}}$	Firm-level estimates based on historical annual accounts data. Elasticities are month specific to account for seasonal factors.
(8)	$\Delta Current assets_m; \Delta Current liabilities_m;$ $Financial revenues_m$	Annual accounts data (table B.1).
(8)	$\partial Depreciation_m = \delta \times \partial Investment_m$	δ is estimated based of firm-level medians using annual accounts data
(8)	$\frac{\partial Sales_m}{Sales_m} \times \varepsilon_{ct} \times Current taxes_m = \tau \times (\partial Sales_m - \partial Inputs_m - \partial Depreciation_m - \partial Interest payments_m)$	Directly inferred from firm-level confidential VAT data.
(8)	$\Delta Debt_m + \frac{\partial Sales_m}{Sales_m} \times \varepsilon_{\Delta dbt} \times \Delta Debt_m = \Delta Debt_m + \partial \Delta Debt_m$	The Central Corporate Credit Register documents all new bank credit on a monthly basis.
(8)	$\frac{\partial Sales_m}{Sales_m} \times \varepsilon_{ip} \times Interest payments_m = \partial Interest payments_m = i \times \partial \Delta Debt_m$	The interest rate is the geometric mean of the MIR-MFI interest rate statistic.
(8)	$\frac{\partial Sales_t}{Sales_t} \times \varepsilon_{ip} \times Interest payments_t \times (1-\tau) =$ $i \times (1-\tau) \times \partial \Delta Debt_t$	See above.
(8)	$\frac{\partial Sales_t}{Sales_t} \times \varepsilon_i \times Investment_t \times \delta \times \tau = \tau \times \delta \times \partial Investment_t$	See above.

Various measures taken by the Belgian authorities in order to prevent businesses from running out of cash are also accounted for:

Table B.3

Equation	Summand	Measurement / Source
(9)	$Credit\ moratorium_m$ $State\ guarantee_m$	Firm-level credit under moratorium as well as new State-guaranteed credit are reported in BECRIS (Belgian Extended Credit Risk Information System), as well as the accompanying date. $State\ guarantee_m$ is defined as the new credit volume under the guarantee scheme. $Credit\ moratorium_m$ is the amount of the monthly loan repayment that is postponed. For details, see NBB (2020a).
(9)	$Temporary\ unemployment_m$	The total firm-level number of firm-level FTEs is taken from the most recent social balance sheet of firms. The number of firm-level FTEs that are temporary unemployed are obtained from the National Employment Office. We apply the fraction of the temporary unemployed workforce to the wage bill reported in 2019Q4.
(9)	$Nuisance/compensation\ premia_m$	Firms which (i) experienced a reduction in turnover of more than 60 % (vis-à-vis the same period last year) or (ii) are forced to fully close down for security measures are entitled to a nuisance premium. We do not observe these payments, but assume firms apply for the premium if they are eligible to do so. As such, we tag firms in the category (i) if their sales drop, as reported in VAT filings, is more than 60 %. Firms are allocated to category (ii) if the firm experiences a sales-drop of 100 % or files for temporary unemployment of the full workforce. The size of the premium varies across Regions.
(9)	$Tax\ policy\ exemptions_m$	*Loss carry-back regime.* Companies' expected losses in income year 2020 can be deduced from the positive result of the prior financial year. This reduces the CIT payable in 2020. In order to apply, firms are required to estimate these income losses. We extrapolate the already observed losses from the VAT data to the full accounting year and assume the firm maximally files for this carry-back scheme if eligible to do so. *Exemption withholding taxes.* To incite re-employment of temporary unemployed in heavily affected sectors, employers are subsidised through an exemption of the payment of part of the withholding tax on wages. More specifically, in June, July and August, 50 % of the increase in withholding taxes compared to what was paid in May 2020, will not have to be paid to the government. This amount can be inferred directly from the firm-level temporary unemployment data. *Investment deduction.* We apply the increased investment reduction on new procurement of investment goods.

Annex C: Main assumptions

We state a set of limiting factors to our analysis and gauge their impact on our estimates.

Assumptions that lead to an overestimation of the cash deficit

i. While we account for temporary unemployment, we impose that the size of the incumbent labour force cannot be adjusted in the short run by firing/hiring. Such an assumption seems reasonable given the limited time frame of our analysis but implies that the framework would be unsuitable for long run projections.

ii. As per the discussion in the body of the text, we only consider a subset of the support packages. While we focus on those measures with the largest budgetary impact, other (niche) support measures can potentially alleviate cash deficits for firms as well.

iii. While we (a) *ex ante* exclude 'dormant firms' from the analysis (i.e. firms that have not filed VAT declarations in the last two years while legally required to do so) and (b) drop entities from March onwards as soon as their bankruptcies are reported in the crossroads-bank-of-firms, we mechanically compound liquidity needs of firms that are formally not yet bankrupt but have nonetheless decided so cease operations.

Assumptions that lead to an underestimation of the cash deficit

i. We focus on firm listed in sector S11 (ESA definition, p.16, 2008), broadly defined as "[…] institutional units which are independent legal entities and market producers, and whose principal activity is the production of goods and non-financial services". In addition, as their behavior is likely not to be governed by the framework developed in this article, we further exclude entities in NACE section K (Financial and insurance activities), O (Public administration and defence: compulsory social security), P (Education), T (Human health and social work activities), Q (Activities of households as employers) and U (Activities of extraterritorial organisations and bodies). Finally, due to data constraints, we focus on entities that file annual accounts. Given these restrictions, a set of entities who have legitimate liquidity and solvency concerns fall outside the scope of the analysis.

ii. The "COVID-19 crisis scenario, without policy interventions" scenario in section 1 aims to quantify the incidence of cash deficits among firms without policy measures (taken on board in section 2). However, our analysis relies on actual sales data running up to September, which reflects indirect policy measures that stimulated household demand (e.g. moratorium for mortgage debt, consumption cheques, etc.). This potentially contaminates the "COVID-19 crisis without policy interventions" scenario with indirect policy measures and therefore already attenuates the liquidity concern.

Assumptions with an ambiguous effect on the cash deficit

i. The analysis takes as a starting point the latest available annual accounts data as a proxy for the actual situation at the start of the crisis. While such an assumption is reasonable for firms that have filed their annual accounts in 2019, for one out of four firms, we rely on more outdated annual accounts filed in 2018.

ii. Part of the analysis relies on estimated elasticities. Provided that elasticities reflect historical behaviour, the question remains as to what extent current behaviour is still governed by these point estimates. E.g. $\varepsilon_{\Delta ca}$ reflects the firms trade credit policy vis-à-vis customers. It might be that, in the context of the COVID-19 crisis, firms tighten their trade credit policy beyond what is implied by the estimated elasticity.

iii. We focus on incumbent firms. New firms, which have entered in the course of 2019 and 2020 which have not yet filed annual accounts, are not included in the estimation.

Annex D: Sector classification

The table below lists the NACE codes and number of firms within each sector.

Sector	NACE code	Number of firms (March 2020)
Agriculture, forestry and fishing	01, 02, 03	5 874
Manufacturing	10-33	22 045
Construction	41-43	54 492
Retail trade of food products	472	4 490
Retail trade of non-food products	451, 453, 454, 471, 473-479	41 733
Accommodation	55	2 413
Food and beverage services	56	22 240
Real estate	68	35 901
Creative activities, arts and culture	90-91	2 196
Sports and recreation	93	3 462
Hairdressing, beauty and wellbeing	9602, 9604	4 043

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Abstracts from the Working Papers series

396. Daily news sentiment and monthly surveys: A mixed-frequency dynamic factor model for nowcasting consumer confidence, by A. Algaba, S. Borms, K. Boudt, B. Verbeken, February 2021

Policy-makers, firms, and investors closely monitor traditional survey-based consumer confidence indicators and treat it as an important piece of economic information. The authors propose a latent factor model for the vector of monthly survey-based consumer confidence and daily sentiment embedded in economic media news articles. The proposed mixedfrequency dynamic factor model framework uses a novel covariance matrix specification. Model estimation and real-time filtering of the latent consumer confidence index are computationally simple. In a Monte Carlo simulation study and an empirical application concerning Belgian consumer confidence, the authors document the economically significant accuracy gains obtained by including daily news sentiment in the dynamic factor model for nowcasting consumer confidence.

397. A bigger house at the cost of an empty fridge? The effect of households' indebtedness on their consumption: Micro-evidence using Belgian HFCS data, by Ph. Du Caju, G. Périlleux, F. Rycx, I. Tojerow, March 2021

The paper investigates the potentially non-linear relation between households' indebtedness and their consumption between 2010 and 2014 in Belgium. To do so, the authors use panel data from the two waves of the Household Finance and Consumption Survey. Unlike previous studies, they find a negative effect of households' indebtedness on their consumption, even in the absence of any negative shock on their assets. Their findings suggest that, without such a shock, it is the daytoday sustainability of the debt, rather than its overall sustainability, that leads households to reduce their consumption. To explore potential non-linearities in this effect, the authors perform a threshold analysis, the results of which suggest that households should not have a debt-service-to-income ratio greater than 30 % as this leads to a substantial reduction of their consumption. The effect appears to be robust to various specifications, not least the inclusion of other European countries, to result from a trade-off between housing and consumption, and seems to be more prevalent among more fragile households.

398. 398. Low interest rates and the distribution of household debt, by M. Emiris, F. Koulischer, March 2021

The authors study how changes in interest rates affect the borrowing of households and the distribution of debt within the population. In a model of household borrowing with credit constraints and endogenous house prices, the authors show that less constrained households with more pre-existing housing wealth increase their borrowing most when interest rates fall. They then use unique loan-level data on the universe of household credit in Belgium to document a shift in the distribution of debt over age, with older households borrowing more as interest rates have fallen in the last decade. First-time borrowers, who are more likely to be constrained, do not contribute to the rise in household debt. To identify the elasticity of household debt to the interest rate, the authors use regulatory data on foreign exposures of banks and on the location of bank branches. They find that a 1 percentage point fall in the interest rate is associated with a 15 % growth in household debt.

399. The interplay between green policy, electricity prices, financial constraints and jobs. Firm-level evidence, by G. Bijnens, J. Hutchinson, J. Konings, A. Saint Guilhem, April 2021

Increased investment in clean electricity generation or the introduction of a carbon tax will most likely lead to higher electricity prices. The authors examine the effect from changing electricity prices on manufacturing employment. Analysing firm-level data, they find that rising electricity prices lead to a negative impact on labour demand and investment in sectors most reliant on electricity as an input factor. Since these sectors are unevenly spread across countries and regions, the labour impact will also be unevenly spread, with the highest impact in Southern Germany and Northern Italy. The authors also identify an additional channel that leads to heterogeneous responses. When electricity prices rise, financially constrained firms reduce employment more than less constrained firms. This implies a potentially mitigating role for monetary policy.

400. Economic importance of the Belgian maritime and inland ports – Report 2019, by I. Rubbrecht, E. Dhyne, C. Duprez, May 2021

In 2019, Belgian ports generated € 32.2 billion in direct and indirect value added (6.8 % of Belgian GDP) and employed 254 009 full-time equivalents (FTEs) either directly or indirectly (5.9 % of Belgian domestic employment including the self-employed). Direct employment at Belgian ports rose by 2 % in 2019 mainly due to additional jobs in cargo handling. Other sectors generated extra jobs too. All Belgian ports except for Brussels contributed to the overall job growth. Direct value added at Belgian ports grew by 1.4 % in 2019. The increase was particularly evident at the ports of Antwerp and Liège, partly owing to wider capacity at nuclear power plants, in comparison to the lower capacity in 2018. At the port of Antwerp, shipping companies faced higher value added. All Belgian ports enjoyed a rise in direct value added.

Sea transport is the dominant transport mode of Belgian international trade in terms of volume to countries outside the EU. The trend in international trade by shipping is explored, with a particular focus on the trade situation during the COVID-19 pandemic.

To contain the spread of COVID-19, governments worldwide imposed stringent containment measures that resulted in huge economic disruptions. A first glimpse of the impact on Belgian ports in 2020 is provided, based on monthly turnover figures.

Conventional signs

EUR	euro
USD	US dollar
%	per cent
bn	billion
e.g.	*exempli gratia*
et al.	*et alia* (and others)
etc.	*et cetera*
i.e.	*id est* (that is)
p.p.	percentage points
p.m.	*pro memoria*

List of abbreviations

Countries or regions

BE	Belgium
DE	Germany
ES	Spain
FR	France
IT	Italy
NL	Netherlands
AT	Austria
EA	Euro area
DK	Denmark
SE	Sweden
EU	European Union
EU28	European Union of 28 countries (still including UK)
AU	Australia
BR	Brazil
CA	Canada
CH	Switzerland
CN	China
IL	Israel
JP	Japan
KR	Korea
MX	Mexico
TW	Taiwan
TR	Turkey
UK	United Kingdom
US	United States

Other abbreviations

AE	Advanced economy
B2B	Business-to-business
BECRIS	Belgian Extended Credit Risk Information System
BIS	Bank for International Settlements
BMPE	Broad macroeconomic projection exercise
CB	Central bank
CCCR	Central Corporate Credit Register
CCGT	Combined cycle gas turbine
CCMT	Climate change mitigation technology
CCS	Carbon capture and storage
CEPR	Centre for Economic Policy Research
CHP	Combined heat and power
CIT	Corporate income tax
CO_2	Carbon dioxide
COVID-19	Disease caused by coronavirus SARS-CoV-2
CPC	Cooperative Patent Classification
CSPP	Corporate Sector Purchase Programme
DSSI	Debt Service Suspension Initiative
DTA	Debt-to-assets ratio
E-mobility	Electric mobility
EBITDA	Earnings before interest, taxes, depreciation and amortisation
EC	European Commission
ECB	European Central Bank
EMBI	JPMorgan's Emerging Market Bond Index
EME	Emerging market economy
EPO	European Patent Office
ERMG	Economic Risk Management Group
ESA	European System of National and Regional Accounts
ESM	European stability mechanism
ESRB	European Systemic Risk Board
EU	European Union
EU ETS	European Union Emissions Trading System
EUIPO	European Union Intellectual Property Office
Euro-PCT	European Patent Cooperation Treaty
Eurostat	European Statistical Office
EV	Electric vehicle
FPB	Federal Planning Bureau
FPS	Federal Public Service
FSB	Financial Stability Board
FTE	Full-time equivalent

G7	Group of Seven, consisting of Canada, France, Germany, Italy, Japan, the United Kingdom and the United States
G20	Group of Twenty
GAAP	Generally accepted accounting principles
GBI-EM	JPMorgan's Government Bond Index-Emerging Markets
GDP	Gross domestic product
GFC	Global financial crisis
GHG	Greenhouse gas
HICP	Harmonised consumer price index
ICE BofA	Intercontinental Exchange – Bank of America
ICT	Information and communication technology
IEA	International Energy Agency
IIF	Institute of International Finance
IMEC	Interuniversity Microelectronics Centre
IMF	International Monetary Fund
IOSCO	International Organization of Securities Commissions
IPO	Initial public offering
IPR	Intellectual property rights
ISCO	International Standard Classification of Occupations
IT	Information technology
LED	Light-emitting diode
l.h.s.	Left-hand side
LGFV	Local government financing vehicle
Ltd	Limited
M&A	Mergers and ccquisitions
MERICS	Mercator Institute for China Studies
MIR-MFI	Monetary financial institution interest rate
MRO	Main refinancing operation
NACE	Statistical classification of economic activities of the European Community
NAI	National Accounts Institute
NBB	National Bank of Belgium
NBER	National Bureau of Economic Research
NCPI	National consumer price index
NEO	National Employment Office
NFC	Non-financial sector
NOx	Nitrogen oxide
NPI	Non-profit institution
NPL	Non-performing loan
OECD	Organisation for Economic Cooperation and Development
OECD/ENV	OECD environment database
PATSTAT	Patent Statistical Database
PCT	Patent Cooperation Treaty
PSPP	Public Sector Purchase Programme
PV	Photovoltaic

R&D	Research and development
RES	Renewable energy source
RFF	Recovery and Resilience Facility
r-g	Difference between the real implicit interest rate and real GDP growth
r.h.s.	Right-hand side
RMB	Chinese renminbi
r-star	Natural or equilibrium interest rate
RTA	Revealed technological advantage
SAFE	Survey on the Access to Finance of Enterprises
SASAC	State-owned Assets Supervision and Administration Commission
SCA	Study Committee on Ageing
SDRM	Sovereign Debt Restructuring Mechanism
SILC	Statistics on Income and Living Conditions
SME	Small and medium-sized enterprise
SNA	System of National Accounts
SO_2	Sulphur dioxide
SOE	State-owned enterprise
SPAC	Special purpose acquisition company
SRIP	Science, Research and Innovation Performance of the EU
Statbel	Belgian Statistical Office
STI	Science, technology and industry
SUERF	*Société Universitaire Européenne de Recherches Financières* (European Money and Finance Forum)
SURE	European instrument for temporary Support to mitigate Unemployment Risks in an Emergency
SWD	Staff and joint staff working documents
VAT	Value added tax
VITO	*Vlaamse Instelling voor Technologisch Onderzoek*

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