II. Gross fixed capital formation in the euro area during the COVID-19 pandemic

By Mirko Licchetta and Eric Meyermans

Abstract: *This section examines the impact of the COVID-19 pandemic on gross fixed capital formation (GFCF) across the euro area. Following the outbreak of the COVID-19 pandemic, the euro area entered an unprecedented recession that induced a sharp fall in GFCF in the first and second quarter of 2020. The contraction was much sharper than at the height of the global financial crisis, but it was very short-lived and a strong rebound followed in the third quarter of 2020. In stark contrast with the period following the global financial crisis, the fall in private investment (as a share of GDP) was partially offset by a rise in public investment (as a share of GDP). The empirical analysis suggests that the extent of the lockdown measures to contain the spread of the virus and the country-specific structure of the economy along with other traditional drivers, in particular, falling output, can explain a large part of the contraction. The bold policy response at the national and EU level mitigated the impact of COVID-19 and supported the recovery. The faster-than-expected rebound in economic activity suggests that the negative economic impact of the pandemic will be more contained than initially feared. However, uncertainty over future health developments remains high, especially given the risks of new more transmissible variants ([20]).*
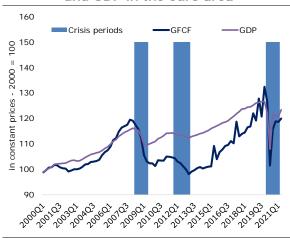
II.1. Introduction

Investment growth has been subdued across the euro area in recent decades. In the short to medium run, investment affects aggregate demand. In the long-run the quantity and quality of the disposable capital stock are important determinants of potential output growth. Investment fell strongly during the global financial crisis and remained at subdued levels for a long time due to a variety of factors including corporate deleveraging, balance sheet repair in the banking sector and consolidation of public finances.

Following the outbreak of the COVID-19 pandemic, gross fixed capital formation (GFCF) in the euro area fell very rapidly in the first and second quarter of 2020 and at a much sharper rate than at the height of the global financial crisis.

The sharp contraction in GFCF prompted many commentators to highlight the risks that the pandemic could lead to another period of subdued investment growth similar to the one following the global financial crisis, when it took about 10 years ([21]) to return to its pre-crisis level ([22]).

Graph II.1: **Gross Fixed Capital Formation and GDP in the euro area**

Source: Eurostat.

However, GFCF recovered (although only partially) at a much faster pace than in the wake of the financial crisis (Graph II.1). The multifaceted and sizable policy response at the national and EU

([20]) The authors wish to thank an anonymous reviewer for useful comments. This section represents the authors' views and not necessarily those of the European Commission.

([21]) In the national accounts (ESA2010), gross fixed capital formation covers machinery, equipment (including transport and ICT equipment), buildings (including dwellings) and structures, as well as cultivated biological resources (including livestock) and intellectual property products (including R&D and computer software and databases). Some expenditures, such as, market

research, advertising, firm-specific human and organisational capital, are treated as intermediate expenditures, but could arguably be treated as investments. See for instance Corrado, C., Haltiwanger, J. and D. Sichel (eds) (2005), *Measuring Capital in the New Economy*, NBER.

([22]) Analysis from the European Central Bank (ECB) shows that after the global financial crisis the loss of capital stock was the main drag on potential output growth. See ECB (2020), 'The scarring effects of past crises on the global economy', *ECB Economic Bulletin* Issue 8/2020.

level mitigated the impact of the crisis [23] and the plunge in GFCF at the onset of the crisis turned out to be short-lived. Investment bounced back forcefully in a context of very strong (and temporarily held back) demand and favourable financing conditions [24]. Public investment picked up considerably, too.

The European Commission Autumn 2021 Economic Forecast and recent surveys suggest that the recovery in GFCF is likely to continue in the coming months. For example, managers from the manufacturing industry expected real investment to increase by 7% in the euro area in 2021 [25] in the wake of a reported 10% decline in 2020 and despite still elevated uncertainty and weaker corporate balance sheets [26].

Continued investment is essential to sustain the economic expansion in the short to medium term, boost potential and support the green and digital transition. In this context, and with a view to draw possible policy lessons going forward, this section examines how the COVID-19 pandemic affected investment across the euro area [27].
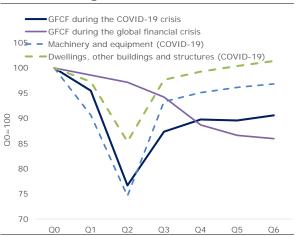
The structure of the section is as follows. The second subsection describes developments in gross fixed capital formation during the COVID-19 crisis comparing it with developments during the global financial crisis. The third subsection explores the role of lockdown measures introduced to supress the spread of the virus and other drivers of GFCF including the rise of uncertainty and the macroeconomic policy response. The fourth subsection provides an overall econometric assessment of the pandemic's impact on GFCF. The fifth section discusses the pandemic's long-term impact on GFCF. The last section draws some conclusions.

II.2. Gross fixed capital formation during COVID-19

II.2.1. Euro area: national accounts

Following the COVID-19 shock, gross fixed capital formation contracted by around 23% between the fourth quarter of 2019 and the second quarter of 2020. Over the same period, GDP fell by 15% and the decline in investment was the second largest cause for this overall contraction (following the drop in consumption). This contraction was much larger than the one recorded following the outbreak of the global financial crisis (Graph II.2) [28]. What was extraordinary about the decline in 2020 was that it all happened in just two quarters. To a large extent, this was due to the tightening of government lockdown measures to contain the spread of the pandemic (see below).

Graph II.2: **Gross fixed capital formation (GFCF) in the euro area during COVID-19 and global financial crisis**

(1) Q0=0 is 2008Q1 = 100 for the global financial crisis and 2019Q4 = 100 for the COVID-19 crisis; Q6 =2009Q3 for the GFC and 2021Q2 for the COVID-19 crisis. Real terms.
Source: Eurostat.

Lower investments in machinery and equipment (excluding the very volatile intellectual property products data) accounted for the majority of the fall to up to the sixth quarter since the outbreak of the crisis (second quarter of 2021) (Graph II.2), but it rebounded strongly in the third quarter of 2020. By contrast, dwellings and other buildings and structures contributed less to the contraction and they had recovered their pre-crisis levels by the first

[23] See Croitorov O. et al. (2021), 'The macroeconomic impact of the Covid-19 pandemic in the euro area', *Quarterly Report on the Euro Area*, Vol. 20, No. 2 (2021.

[24] See European Commission (2021), *Autumn 2021 Economic Forecast*.

[25] See European Commission (2021), *Business and Consumer Survey* carried-out in April 2021.

[26] See ECB (2021), Survey on the Access to Finance of Enterprises (SAFE), June 2021.

[27] It complements policy-oriented analyses presented in the *Quarterly Report on the Euro Area*, Vol. 20, numbers 1 and 2 and other research such as Pfeiffer, P., Roeger W. and J. In 't Veld (2020). 'The COVID-19 pandemic in the EU: Macroeconomic transmission and economic policy response', *ECFIN Discussion Paper* 127.

[28] For comparison, GDP in the first quarter of 2009 declined by around 5½ % relative to the first quarter of 2008, whereas investment fell by around 11%.
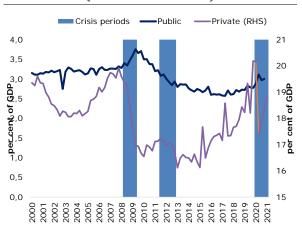
quarter of 2021. Investment in intangibles, such as research and development ([29]), fell relatively less than machinery and equipment.

II.2.2. Euro area: sector accounts

At the institutional sector level, the fall in private investment was partly compensated by a symmetric rise in public investment as euro-area governments pledged substantial public investment to support the recovery from the pandemic. This was in stark contrast to the period following the global financial crisis (Graph II.3), which saw euro-area governments cutting back on public investment with the aim of consolidating public finances.

The combination of national and EU funding ([30]) implies a pick-up in public investment spending, with the European Commission's Autumn 2021 Economic Forecasts seeing public investment rise to 3.5% of GDP in 2022 and 2023, its highest level since 2010.

Graph II.3: **Public and private investment (as a share of GDP)**

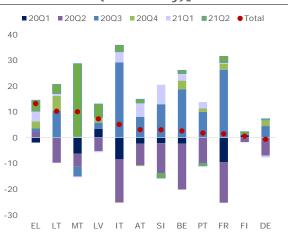**Source:** Eurostat, Institutional sector accounts.
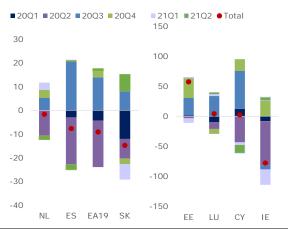
II.2.3. Member State level

The depth of the decline in GFCF between the fourth quarter of 2019 and the second quarter of 2020 varied widely within the euro area, ranging from just below 1% in Finland to 80% in Ireland (Graph II.4). Intellectual property − a key and

growing component of GFCF − has been particularly volatile in Ireland, Estonia, Cyprus and Luxembourg (see bottom-right hand side in Graph II.4) ([31]).

Graph II.4: **Changes in gross fixed capital formation since the onset of COVID-19 (scales vary)]**

(1) Data on GFCF for IE, CY, LU and EE show very strong volatility in the intellectual property investment component.
(2) Total growth (red bullet) measures the compound growth rate (i.e. multiplicative). Given the large size of the growth rates, adding quarterly growth rates (coloured bars) is only a rough approximation of the total growth rate between the first quarter of 2020 and second quarter of 2021.
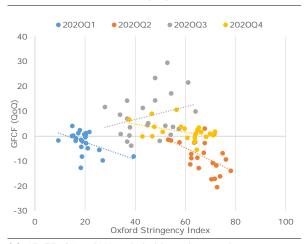**Source:** Eurostat, National accounts

Part of these cross-country differences in investment growth can be attributed to differences in the intensity of the lockdown measures - with tighter measures associated with stronger decreases in gross fixed capital formation (the second quarter of 2020 in Graph II.5).

([29]) Once again, the volatile Ireland data are excluded.

([30]) Overall, the Recovery and Resilience Plan's total GDP impact generated during the 2021-2022 period is expected to be approximately 1.2% of the EU's 2019 real GDP, with a noticeable impact on the GFCF for a significant number of Member States. See European Commission (2021), *Spring 2021 Economic Forecasts.*

([31]) For this reason these four Member States were not included in the empirical assessment in section 4.

As restrictions on movement were lifted between the end of the second and the third quarter of 2020, GFCF rebounded in the third quarter of 2020 (See Graph II.5). Restrictive measures were tightened again in the fourth quarter of 2020 on the back of renewed pressures on the Member States health systems but the economic impact of the second lockdown was more contained than that of the first one.

Graph II.5: **Change in gross fixed capital formation and Oxford stringency index in 2020**

(1) IE, EE, CY and LU excluded from the sample.
(2) In this unconditional correlation between GFCF and the level of the Oxford stringency indicator the latter proxies all COVID-19 related factors at that moment. Further refined regression analysis (sub-section II.4) focusses on the effects of first differences of Oxford stringency indicator as well as other relevant factors separately.
Source: Eurostat and Oxford Stringency Index.

II.3. COVID-19 related drivers of GFCF

Several COVID-19 specific factors can explain the contraction in GFCF and they are briefly discussed as follows.

Stringent lockdown measures

The literature suggests a strong negative relationship between governments' lockdown measures and GDP (including its components). This negative impact increases with the intensity of the measures (e.g. IMF (2020) [32] and Niermann and Pitterle (2021) [33]), the importance of tourism

in the economy and lower quality of governance (e.g. Sapir 2020 [34]). However, over time, economic activity became less sensitive to the stringency of lockdown measures as firms and households adapted to the new environment (see also Graph II.5) [35].

Rising uncertainty

Both expectations and uncertainty about future developments affect investment. However, it is very difficult to disentangle these factors, especially at the macro level [36]. Moreover, the expected duration of the lockdown measures was a very specific pandemic related channel that affected investment. For example Buchheim et al. (2020) [37] report that in the early phase of the pandemic firms that expected the lockdown to last longer were more likely to postpone investment and lay-off workers [38].

Rising uncertainty affects investment via several channels including the postponement or cancellation of investment (especially when irreversible), a rising interest rate risk premium effect, and a reverse accelerator effect when output falls below its potential following for instance a sharp fall in household consumption. However, well-designed monetary and fiscal policies can mitigate the negative impact of an increase in uncertainty.

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[32] IMF (2020), 'A Long and Difficult Ascent', *World Economic Outlook*, October, presenting an analysis covering a sample of up to 52 advanced, emerging market, and developing economies.

[33] Niermann, L. and I. Pitterle, 2021, 'The COVID-19 crisis: what explains cross country differences in the pandemic's short-term economic impact?', *MPRA Paper* No. 107414, presenting a sample covering 156 developed, developing and transition economies.

They report that one standard deviation in countries' 2020 average stringency corresponds to at around 1 percentage point reduction in 2020 growth estimates, all else equal.

[34] Sapir, A. (2020), 'Why has COVID-19 hit different European Union economies so differently', *Bruegel Policy Contribution Issue* n°18.

[35] See also results in section II.4.

[36] For instance Koetse, M., van der Vlist, A. and H. de Groot (2006), 'The Impact of Perceived Expectations and Uncertainty on Firm Investment', *Small Business Economics*, Vol. 26, pp. 365–376 using granular Dutch firm level data, report that expectations and uncertainty about input- and output prices and domestic demand have substantial but different effects on investment spending in firms of different sizes as for instance large firms may have better opportunities to hedge against risk and uncertainty than small firms.

[37] Buchheim, L., Dovern, J., Krolage, C. and S. Link (2020), 'Firm-level Expectations and Behavior in Response to the COVID-19 Crisis', *IZA Discussion Paper* No. 13253, making use of a representative sample of approximately 9 000 German firms in all relevant sectors of the economy during the first phase of the pandemic.

[38] In the absence of harmonised cross country indicators for expectations, this channel is proxied by the equity book ratio in the reduced-form regression analysis presented in sub-section 4.

Early evidence suggested that higher uncertainty in the initial phase of the COVID-19 crisis [39] took a toll on business investment [40]. For example, surveying about 13.500 firms across the EU in 2020, EIB (2020) [41] reports that about 80% of EU firms considered uncertainty to be an impediment with some 50% of firms even considering it a major impediment [42] [43]. Gieseck and Rujin (2020) report that heightened uncertainty could have accounted for around one-fifth of the decline in activity by the first half of 2020, with a particularly strong impact on fixed capital formation [44].

Short-lived tightening of financial conditions

At the beginning of the COVID-19 crisis, financing conditions tightened somewhat given the overall uncertainty of the scale and duration of the crisis. However, the increase was short-lived (Graph II.6), following a strong monetary policy response preventing that financing conditions for the economy would tighten in a pro-cyclical way [45].

Further financial relief was provided under various state credit guarantee programmes that supported solvable firms' access to finance for investment [46].

Graph II.6: **Non-financial corporations (NFC) cost of credit and composite financial condition indicator (CFCI)**

Source: European Commission.

The policy response at Member States and EU level

Monetary and supervisory authorities supported the financing of investments in several ways. The ECB's monetary policy response mainly consisted of additional asset purchases including via the pandemic emergency purchase programme (PEPP), ample liquidity provision (mostly via targeted long-term refinancing operations), and easing of collateral standards, while maintaining the deposit facility rate at a record low of -0.5% (since September 2019). At the same time, several national macro-prudential authorities reduced countercyclical capital and systemic risk buffers [47], while the Single Supervisory Mechanism (SSM) allowed banks to meet part of their core capital requirements with non-core capital instruments.

The policy responses at the EU level that supported investment included the mobilisation of all available cash reserves from the European Structural and Investment Funds, putting in place the European instrument for temporary Support to mitigate Unemployment Risks in an Emergency

(39) See EU Commission (2021) 'Economic Sentiment and Employment Expectations up in the EU and the euro area' (October 2021). See also 'Special topic: new survey-based measure of economic uncertainty'. Gayer, C., Reuter, A. and F. Morice (2021), 'Special topic: new survey-based measure of economic uncertainty', *Vox EU*.

(40) With higher uncertainty, firms might become more cautious and postpone or cancel their investments, especially in the case of irreversible investments. See Pindyck, R. (1991), 'Irreversibility, Uncertainty, and Investment', *Journal of Economic Literature*, Vol. XXIX, pp. 1110-1148) and Bloom, N., Bond, S. and J. Van Reenen (2007), 'Uncertainty and Investment Dynamics', *The Review of Economic Studies*, Vol. 74, No 2, pp. 391-415.

(41) EIB (2020), The EIB Investment Survey, 2020 EU overview.

(42) Rivera Garrido B. and L. Maurin (2020), 'The cash conundrum: nature and implications for the post-COVID environment?', *EIB Working Paper*. See also Meyermans, E., Rutkauskas, V. and W. Simons (2021), 'The uneven impact of the COVID-19 pandemic across the euro area', *Quarterly Report on the Euro Area*, Vol. 20, No. 2, pp. 17-30.

(43) Likewise, Commission (2020), *EU R&D Survey*, reports that firms expected a contraction of 4.5% in capital expenditure in 2020 with more than 40% of participants indicating negative expectations.

(44) Gieseck, A. and S. Rujin (2020), 'The impact of the recent spike in uncertainty on economic activity in the euro area', *ECB Economic Bulletin*, Issue No. 6/2020.

(45) Lane, P. (2020), 'The Monetary Policy Package: An Analytical Framework', *ECB Blog* 13 March 2020.

(46) European Commission (2020), Policy measures taken against the spread and impact of the coronavirus – 8 December 2020

(47) See the ECB macroprudential measures website for more details on policies aimed at increasing the financial system's resilience to shocks by addressing possible systemic risks across the euro area.

(SURE) [48] and the creation of the recovery instrument Next Generation EU (NGEU) [49].

At the national level, the fiscal authorities supported investments via several measures facilitated by the activation of the general escape clause of the Stability and Growth Pact. These measures included emergency spending on health care, short-time work schemes, grants, loan guarantees, loan repayments moratoria, tax deferrals [50], liquidity support and the roll-out of a vaccination programme.

II.4. Empirical results

The impact of the COVID-19 pandemic on quarterly growth in gross fixed capital formation across the euro area is estimated via a panel error correction model (see Box II.1). The model relates investment to output, the past change in capital stock which requires investment to offset capital depreciation [51], financing costs, a news-based measure of uncertainty [52] and the equity-to-book ratio. To account for the impact of the pandemic, this base model is augmented to include lockdown measures using the Oxford stringency index [53], a pandemic dummy (equal to 1 for the length of the pandemic since the second quarter of 2020 [54])

that captures the net impact of other factors including fiscal and monetary policy responses [55].

Lockdown measures

The econometric results suggest that quarterly growth in GFCF decreases with the tightening of lockdown measures. This statistically significant finding suggests that a 10-points tightening in the Oxford stringency index leads on average to a contraction of about 2.5 ppt in GFCF quarter on quarter growth (variant 1 in Table B in Box II.1).

The sensitivity of GFCF to the lockdown measures (variant 2 in Table B in Box II.1) [56] decreases over time [57]. This perhaps reflects learning from experiences and gradual adaptation, which includes greater digitalisation. Along these lines, earlier research [58] reports that the impact of the second and third wave on turnover in the various countries was substantially different from that of the first wave, as turnover reductions were relatively subdued in the Member States that suffered most in the first wave.

The sensitivity of GFCF differs also across Member States. It is the strongest in Italy and the weakest in Malta and Finland (variant 3 in Box II.1 and Graph II.7) [59]. Such cross-country differences in responsiveness to the lockdown measures might reflect differences in economic structure such as the share of tourism and contact-intensive sectors in the economy [60]. Graph II.8 confirms that the responsiveness to the lockdown measures increase with the size of contact-intensive sectors (as a share in total gross value added). In

[48] See McDonnell, C. et al. (2021), 'The SURE instrument – key features and first assessment', *Quarterly Report on the Euro Area*, Vol. 20, No. 2, pp. 41-49.

[49] See Alfman, E. et al. (2021), 'An overview of the economics of the Recovery and Resilience Facility', *Quarterly Report on the Euro Area*, Vol. 20, No. 2, pp. 7-17.

[50] And in some countries the introduction of temporary suspensions of bankruptcy proceedings.

[51] Net capital stock data with quarterly frequency are interpolated from AMECO annual capital stock series OKND.

[52] Uncertainty is measured by the Economic Policy Uncertainty index based on newspaper articles regarding policy uncertainty. However, part of the impact of rising uncertainty may also be captured by other explanatory variables such as the pandemic dummy and lockdown measures.

[53] The Oxford COVID-19 stringency index varies between 1 and 100 (1= very loose, 100 = very tight). It includes several dimensions: (i) lockdown and closure measures (including school closing, workplace closing, cancelation public events, restrictions on gathering size, closing of public transport, stay-at-home requirements, restrictions on internal movement, and restrictions on international travel); (ii) economic response (including direct cash payments to people who lose their jobs or cannot work, debt/contract relief for households in danger of loosing access to services like water, announced fiscal measures and COVID-19 related international support) and (iii) health system measures (including public information campaign, testing policy, contact tracing, emergency investment in health, investment in COVID-19 vaccines, facial coverings and vaccination policies). See Halle, T. et al. (2020), 'A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker)'.

[54] Complemented with a dummy for the first quarter of 2020 as the first weeks of this quarter were not yet affected by the pandemic.

[55] I.e. a dummy equal to 1 for the length of the pandemic since the second quarter of 2020, complemented with a dummy equal to 1 for the first quarter of 2020.

[56] Variant V2 in Box II.1 allows the point estimate of the lockdown measures to vary across the 6 quarters during which the pandemic was hitting the euro area.

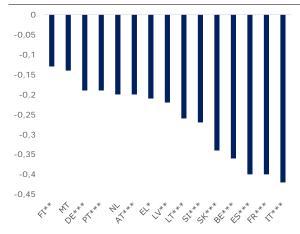[57] The positive value of the point estimate in the second quarter of 2021 in variant V2 is somewhat puzzling.

[58] See for instance, Meyermans, E., Rutkauskas, V. and W. Simons (2021), *op. cit.*

[59] Variant V3 in Box II.1 allows for the point estimate of the lockdown measures to vary across the 15 euro area Member States in the sample.

[60] Coutinho, L., Vukšić, G. and S. Zeugner (2021), 'International tourism decline and its impact on external balances in the euro area', *Quarterly Report on the Euro Area*, Vol. 20, No.2, pp. 31-40, provide further evidence on how the lockdown measures that included restrictions on activities in the hospitality sector and on international travel had a strong adverse impact on tourism. This affected especially euro area countries with large tourism sectors, thereby also triggering a further deterioration of some countries' trade balance.
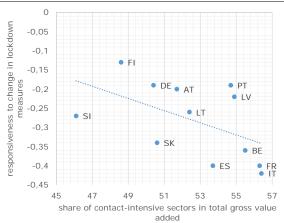
turn, these lockdown measures lowered private consumption and exports, thereby putting additional downward pressure on GDP and consequently also on investment.

Graph II.7: **Responsiveness to a change in lockdown measures across the euro area**

(1) Based on Variant V4 in Table B in Box II.1.Point estimate significance *** p<0.001, ** p<0.05 and * p<0.
Source: Authors' estimates.

Graph II.8: **Sensitivity to a change in lockdown measures and share of contact-intensive sectors in value added**

(1) Contact-intensive sectors refer to wholesale and retail trade, transport, accommodation and food service activities (NACE2 Rev2 classification: G-I), arts, entertainment and recreation (R-U); information and communication (J), financial and insurance activities (K), real estate (L), professional, scientific and technical activities (M), and administrative and support service activities (N). Only Member States with 0.05 significance.
Source: Authors' estimates and Eurostat national accounts

The policy response

The pandemic dummy is found to be statistically significant (see variant 1 in Table B of Box II.1).

As such, the dummy captures the role of various factors including the response of monetary and fiscal policy during the COVID-19 crisis. To better understand the impact of the policy response on GFCF, the base model (variant 1) is augmented with a proxy for monetary and fiscal policy interventions (see variant 4 in Table B of Box II.1). At the same time, the parameter of the confinement measures is kept constant over time and across Member States and a dummy to capture all other COVID-19 related factors is kept.

The change in the ECB balance sheet (as measured by the change in total liabilities during the pandemic) is used as a proxy for the monetary policy related intervention. As for the fiscal policy response, it is measured by general government net lending (as a share of GDP).

The significant positive point estimate for monetary policy suggests that it supported investment through the normalisation of financial market conditions and the provision of credit to the banking sector at favourable rates, which helped banks to grant loans to solvable firms [61]. Interestingly, both the monetary policy and financing conditions positively affect GFCF. As the latter reflects mostly market risk premia, the effects of the ECB policy measures are already captured by the financing condition variable. The presence of an additional, large and positive impact of ECB balance sheet policies on GFCF could reflect confidence related effects [62].

The significant negative point estimate for the public budget balance suggests that the increase in the headline deficit supported investment by countering the downward impact of the pandemic shock on aggregate demand [63] [64].

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[61] Caveat, keeping the coefficients fixed over time and per country may imply that the lower sensitivity of households and firms to lockdown measures during the second phase of the COVID-19 crisis is not captured. As a result there is a risk of overestimating the impact of the policies.

[62] Schnabel, I. (2021), 'Asset purchases: from crisis to recovery', speech delivered at the Annual Conference of Latvijas Banka on 'Sustainable Economy in Times of Change'.

[63] Taking first differences of GGNB reduces its significance.

[64] On the combined effect of monetary and fiscal policy following the outbreak of the pandemic, Bellia, M., Calès, L., Frattarolo, L., Monteiro, D. and M. Petracco Giudici (2021), 'COVID-19: the stabilising impact of EU bond issuance on sovereigns and banks', *Quarterly Review on the Euro Area*, Vol.20, No. 3, pp. XX suggests that the introduction of EU bond issuance together with the Eurosystem asset purchases will increase the diversification of the government bond portfolio of the banking sector and support its

Box II.1: The impact of COVID-19: a regression analysis

This box shows estimation results for a panel error correction model, covering 15 euro area Member States [1] from the first quarter of 2002 to the second quarter of 2021 [2]. First, the equilibrium relationship is estimated between the level of gross fixed capital formation (I) to traditional long-term determinants, i.e. the level of real GDP (GDP), the financing cost (USER) [3], the equity to book value ratio (PB_ratio) [4] and a global financial crisis dummy (DUM_GFC). To capture the specific impact of the pandemic this equilibrium relationship is augmented with the Oxford stringency indicator (LOCKDOWN) and a dummy for the net impact of all other factors affecting investment during the pandemic including a proxy for the monetary and fiscal policy response to the crisis (DUM_COVID) [5]. More specifically, the estimated equation is:

(1) $\ln(I_{it}) = \beta_0 + \beta_1 \ln(GDP_{it}) + \beta_2 USER_{it} + \beta_3 PB\_ratio_{it} + \beta_4 LOCKDOWN_{it} + \beta_5 DUM\_COVID_t + \beta_6 DUM\_GFC_t + ECT_{it}$

with the subscripts i and t referring to the countries and quarters respectively, and whereby $\beta_1, \beta_3 > 0$ while $\beta_2, \beta_4, \beta_6 < 0$ and the sign of β_5 is ambiguous as it covers a whole range of transmission channels. ECT is the error correction term used in the second step of the regression analysis. Table A shows that the point estimates all have the expected sign. The Pedroni and Kao panel cointegration test suggests that the null-hypothesis of no cointegration can be rejected at a high level of confidence, indicating that the proposed relationship constitutes an equilibrium relationship towards which the economy will converge once all short-term rigidities have petered out [6].

Table A: Equilibrium (semi-)elasticities

	GDP	USER	PB_ratio	LOCKDOWN	DUM_COVID	DUM_GFC
Equilibrium (semi-) elasticities	0.99	-0.56	0.14	-0.14	0.08	-0.02

Note: sample size 2002Q1-2021Q2, including BE, DE, EL, ES, FR, IT, LV, LT, MT, NL, AT, PT, SI,SK and FI.

Next, the short to medium term dynamics is estimated with pooled generalised least squares [7], using lagged variables and Hodrick-Prescot filtered series as instrumental variables [8], i.e.

(2) $\Delta \ln(I_{it}) = \gamma_0 + \sum_{j=1}^{4} \gamma_{1j} \Delta \ln(GDP_{it-j}) + \gamma_2 \Delta \ln(Capital_{it-1}) + \gamma_3 \Delta USER_{it} + \gamma_4 \Delta PB\_ratio_{it} + \gamma_5 \Delta LOCKDOWN_{it} + \gamma_6 DUM\_COVID_t + \gamma_7 DUM\_GFC_t + \gamma_8 ECT_{it-1} + u_{it}$

with Δ the operator comparing one quarter to the previous quarter, and with $\sum_{j=1}^{4} \gamma_{1j} > 1, \gamma_2, \gamma_4 > 0$.

Table B reports the main estimation results which are discussed in more detail in subsection II.4. Variant V1 is the baseline model capturing the dynamics towards equilibrium. Most point estimates have the expected sign and are statistically significant. Several robustness tests were performed, indicating that the qualitative nature of the results in Variant 1 is broadly unchanged if (i) a more stricter version of the Oxford indicator that focuses only on mobility restrictions is considered (variant V1-lockdown), (ii) investment in dwellings is

[1] I.e. BE, DE, EL, ES, FR, IT, LV, LT, MT, NL, AT, PT, SI,SK and FI. IE, EE, CY and LU are not included as they show strong variability (or are confidential as in the case of IE in some quarters) in the intellectual property products component.
[2] The main data sources are Eurostat National Accounts and Sectoral Accounts, Oxford COVID-19 Government Response Tracker project and AMECO.
[3] I.e., the real user cost of capital measured as $USER_{it} = \frac{IR_{it} + \tau - \left(\frac{PC_{it+1}}{PC_{it}} - 1\right)(1-\tau)}{1 + IR_{it}} \frac{PC_{it}}{P_{it}}$, with IR the measured as the bank lending rate, τ the rate of capital depreciation, PC the price of capital, and P the price of output. The expected price change is assumed to be equal to the observed past change.
[4] The Price/Book Ratio for the Europe STOXX 600 Index is taken as a proxy for the Tobin Q.
[5] I.e. a dummy equal to 1 from the first quarter of 2020 to the second quarter of 2021, and zero during all other periods.
[6] The Pedroni and Kao panel cointegration test extend the Engle-Granger framework to tests involving panel data, allowing for heterogeneity in the long-run cointegrating vectors among individual members of the panel. The panel cointegration test statistics are obtained from the EVIEWS econometric software.
[7] Allowing for correlation between the random components across Member States.
[8] Used to avoid potential simultaneity biases in the point estimates of some explanatory variables such as the financing cost, uncertainty measure and equity to book value ratio, as these variables may be correlated with the error term of the regression equation. The instrumental variables include the policy variables excluding its cyclical component estimated via the Hodrick-Prescot (HP) filter.

bank loans for investment.

(Continued on the next page)

Box (continued)

excluded (variant V1-dwellings), (iii) the error correction term is estimated excluding pandemic related variables ([9]) (variant V1-technical), (iv) replacing the change in the lockdown measures by its level did not change the significance of the point estimates, (v)estimation period is limited to the pre-pandemic period from the first quarter of 2001 until the fourth quarter of 2019 (Variant V1-pré 2020), (vi) for some important COVID-19 related factors such as the vaccination rate that took off in the first quarter of 2021 not enough degrees of freedom are available to obtain stable estimates.

Table B: Point estimates of the panel error correction model

(in natural logarithm changes of one quarter compared to the previous quarter)

Dependent variable: d ln of investment in constant prices

	V1	V1-lockdown	V1-dwellings	V1-technical	V1-pré2020	V2	V3	V4
First lag of real GDP growth	0.40 ***	0.29 ***	0.40 ***	0.55 ***	1.10 ***	0.55 ***	0.38 ***	0.68 ***
Second lag of real GDP growth	0.08	0.11	0.09	0.15	0.11	0.15	0.08	0.23 **
Third lag of real GDP growth	0.17 *	0.22 **	0.19 *	0.23 **	0.39 *	0.33 ***	0.16 *	0.44 ***
Fourth lag of real GDP growth	0.24 *	0.23 *	0.21	0.33 **	-0.28	-0.02	0.24 *	-0.20
First lag of capital stock growth	0.03 ***	0.03 ***	0.04 ***	0.03 ***	0.03 ***	0.03 ***	0.03 ***	0.03 ***
Change in financing cost (USER)	-0.46 **	-0.42 **	-0.46 **	-0.45 **	-0.27	-0.41 **	-0.42 **	-0.35 *
GFC dummy	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
Newsbased risk index (UNCER)	0.00 **	0.00 **	0.00 **	-0.00 ***	0.00 *	0.00 *	0.00 **	0.00 *
Change in equity/book ratio (PB_ratio)	0.05 ***	0.05 ***	0.05 ***	0.03 *	0.05 ***	0.05 ***	0.05 ***	0.05 ***
Change in ECB liabilities during pandemic (ECB_L)								0.55 **
Public budget balance (% of GDP) during pandemic								-0.77 *
Change in lockdown measures (all) (LOCKDOWN)	-0.27 ***		-0.26 ***	-0.25 ***				-0.34 ***
Change in lockdown measures 20Q1 (all)						-0.56 ***		
Change in lockdown measures 20Q2 (all)						-0.26 ***		
Change in lockdown measures 20Q3 (all)						-0.46 ***		
Change in lockdown measures 20Q4 (all)						-0.26 **		
Change in lockdown measures 21Q1 (all)						-0.23		
Change in lockdown measures 21Q2 (all)						0.43 **		
Change in lockdown measures (only mobility)		-0.32 ***						
Pandemic dummy (DUM_COVID)	0.04 ***	0.05 ***	0.05 ***	0.05 ***		0.04 ***	0.04 ***	-0.03
Pandemic dummy 2020Q1	0.02	0.02	0.02	0.02		0.08 *	0.02	0.04 *
Lagged error correction term (ECT)	-0.14 ***	-0.15 ***	-0.24 ***	-0.11 ***	-0.12 ***	-0.14 ***	-0.14 ***	-0.13 ***
Change in lockdown measures (all) - BE							-0.36 ***	
Change in lockdown measures (all) - DE							-0.19 ***	
Change in lockdown measures (all) - EL							-0.21 *	
Change in lockdown measures (all) - ES							-0.40 ***	
Change in lockdown measures (all) - FR							-0.40 ***	
Change in lockdown measures (all) - IT							-0.42 ***	
Change in lockdown measures (all) - LV							-0.22 **	
Change in lockdown measures (all) - LT							-0.26 ***	
Change in lockdown measures (all) - MT							-0.14	
Change in lockdown measures (all) - NL							-0.20	
Change in lockdown measures (all) - AT							-0.20 ***	
Change in lockdown measures (all) - PT							-0.19 ***	
Change in lockdown measures (all) - SI							-0.27 ***	
Change in lockdown measures (all) - SK							-0.34 ***	
Change in lockdown measures (all) - FI							-0.13 **	
Autocorrelation of error term	-0.37 ***	-0.36 ***	-0.35 ***	-0.37 ***	-0.41 ***	-0.39 ***	-0.37 ***	-0.40 ***
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.29	0.30	0.30	0.27	0.31	0.32	0.30	0.33
Number of observations	1082	1082	1010	1082	992	1082	1082	1059
Number of explanatory variables	29	29	28	29	26	34	43	31

Note: sample size 2002Q1-2021Q2, including BE, DE, EL, ES, FR, IT, LV, LT, MT, NL, AT, PT, SI,SK and FI. Natural logarithm changes of one quarter compared to the previous quarter. Net capital stock data with quarterly frequency are interpolated form AMECO annual capital stock series OKND.

Note: Pooled generalised least squares , and with lagged and Hodrick-Prescot filtered series as instrumental variables. Country fixed effects included.

Note: point estimate significance *** p<0.001, ** p<0.05 and * p<0.1.

[9] In all variants, except V2-technical, the error correction term, ECT, for the entire sample is estimated based on a regression of equilibrium equation (1) as reported in Table A. For variant V2-technical the error correction terms are obtained re-estimating equation (1) for a sample ending in the fourth quarter of 2019, and fitting the error correction term from the first quarter of 2020 to second quarter of 2021 using observed explanatory variables and point estimates of the re-estimated equation (1).

Finally, Graph II.9 provides an overview of the contribution of the various drivers of GFCF during the COVID-19 crisis.

II.5. Long-term impacts of COVID-19

The pandemic poses both upside and downside risks for gross fixed capital formation.

Upside risks

The pandemic accelerated investment in information and communications technology (ICT) infrastructure ([65]) to accommodate the rise in online work and digital sales. The McKinsey Global Institute Report (2021) ([66]) expects such changes have the potential to increase annual productivity growth by about one percentage point up to 2024. It is also notable that during the pandemic investment in intellectual property products (e.g. investment in software and research
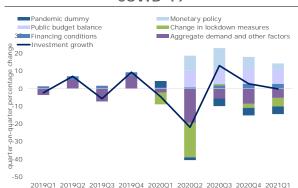
[65] Bellmann L. et al (2021), 'The pandemic has boosted firm investments in digital technologies', *VoxEU*, report that almost 30% of the surveyed German companies reported that the pandemic accelerated the introduction of digital technologies.

[66] See McKinsey Global Institute Report (2021), Will productivity and growth return after the COVID-19 crisis?

and development) - that are key drivers in the knowledge economy - held up better than investment in machinery and equipment. This might be because the exchange of intellectual property products involves less physical interaction.

Graph II.9: **Decomposition of the changes in gross fixed capital formation during COVID-19**

(1) Model estimation based on variant V4 in Table B in Box II evaluated for the explanatory variables at EA19 aggregate, i.e. the plotted value is equal to the corresponding point estimate multiplied with the observed change/level of the explanatory variable.
(2) Legend: 'Pandemic dummy' refers to the variable DUM_COVID in equation (2) of Box II.1, 'Change in lockdown measures' refers to variable LOCKDOWN, 'Financing condition' refers to the sum of variables USER, PB_ratio and UNCERTAINTY, 'Public budget balance' refers to GGNB, 'Change in ECB liabilities' refers to ECB_L.
Source: Authors' estimates.

The pandemic also disrupted the functioning of global value chains (GVCs). The fear of a repeat of a pandemic may then strengthen the incentives to bring production closer to home [67], thus requiring additional investment. At the same time, such reshoring may limit countries' opportunities to exploit their comparative advantages thereby lowering the return on capital and incentives to invest. The available evidence on the impact of COVID-19 on GVCs is, however, somewhat ambiguous [68].

Downside risks

Available evidence suggests that much of the long-run damage initially feared from the COVID-19 crisis has been avoided thanks to the bold policy response at the national and EU level. However, risks remain that might dampen investment going forward, especially in case of a re-intensification of the pandemic [69].

If emergency policy support measures for firms are lifted too abruptly, this might contribute to an increase in corporate distress. This in turn may intensify the financing constraints on investment [70]. For example, OECD (2021) [71] expects insolvencies to increase significantly in the next two years, particularly in high-contact services sectors, admittedly from artificially low levels. Near-term euro-area corporate insolvency concerns have however fallen, although some sectors remain vulnerable, notably accommodation and food [72]. European Commission (forthcoming) [73] estimates that about 5% of additional firms would be financially vulnerable by the end of 2021 as compared with a counterfactual scenario with no impact of COVID-19 on profits because of the depletion of equity following protracted periods of losses, and from an increased debt burden.

At the same time, the continuation of support policies could carry the risk of locking capital and labour in unproductive sectors, hindering business dynamism over the medium-to-long term [74].

[67] See Javorcik B, (2020), 'Global supply chains will not be the same in the post-COVID-19 world' in Baldwin, R. and S. Evenett (eds., 2020), *COVID-19 and Trade Policy: Why Turning Inward,* expects that primarily Eastern European and the Southern Mediterranean countries will benefit from 're-shoring' or 'near-shoring'.
[68] The pandemic limited the mobility of goods and persons including managers but it gave a boost to digitalisation. See Simola, H. (2021), 'The impact of Covid-19 on global value chain', *BOFIT Policy Brief,* 2021 No. 2, Bank of Finland.

[69] See IMF (2021), 'Austria – Selected Issues', *Staff Country Report*, arguing that many countries experienced a persistent output loss compared to the pre-crisis trend after a large crisis such as a currency crisis, health crisis, civil wars and systemic banking crisis. The magnitude of the losses ranges from less than 5% (currency crisis and health crisis), to over 10% (civil wars).
[70] Based on a sample of 800 listed companies in the euro area and the UK, Jegard, T. and S. Ray (2021), 'The Macroeconomics of Covid-19 Leverage', *SUERF Policy Note,* No. 232, report that the COVID-19 induced a change in balance sheet composition form equity to debt borrowing to cover significant liquidity needs resulting from the COVID-19 pandemic.
[71] OECD (BIAC) (2021), *Economic Policy Survey.*
[72] ECB, 2021, Financial Stability Review, November. See also Bondt, G., Gieseck, A., Nicoletti, G., and M. Tujula (2021). 'Non-financial corporate health during the pandemic', *ECB Economic Bulletin* 6, September.
[73] See European Commission (forthcoming), 'Corporate Vulnerability and Structural Developments post COVID-19: Challenges and Policy Responses', *Note for the Eurogroup* (
[74] See Claeys, G., M. Hoffmann and G. Wolff (2021) 'Corporate insolvencies during COVID-19: keeping calm before the storm', Bruegel Blog, 7 January; Ebeke C., N. Jovanovic, L. Valderrama, and J. Zhou, 'Corporate Liquidity and Solvency in Europe during COVID-19: The Role of Policies', IMF Working Paper, No. 21/56 and Laeven L., G. Schepens and I. Schnabel, 'Zombification in Europe in times of pandemic', VoxEU.

Nevertheless, preliminary evidence suggest that this effect remains modest ([75]), and that business creation has rebounded since the second quarter of 2021 ([76]). Moreover, available research ([77]) suggests also that firms that received support are more positive about their investment outlook, as they found themselves in a better position to crowd-in investors and recapitalise.

Excessive corporate debt burden accumulated during the pandemic could also act as a drag on investment ([78]). For example, non-financial corporations' debt-to-GDP ratio (consolidated measure) rose from 77.2% in the first quarter of 2020 Q1 to 84.7% in the first quarter of 2021 – of which the largest part seems to be concentrated in a subset of already highly leveraged companies.

Such increases in debt might strengthen deleveraging needs thereby discouraging investment. For example, the Organisation for Economic Cooperation and Development (OECD) (2021) ([79]) reports that, on average, a percentage point increase in the equity leverage ratio between 2019 and 2020 was associated with a 2% drop in capital expenditures, suggesting that the persistence of a debt build-up strategy will ultimately weigh on investment in the medium term ([80]).

Finally gross fixed capital formation differed notably across euro-area Member States during the pandemic (see Graph II.4 above). If these differences persist, they could lead to widening growth differentials in potential output, thereby weakening the convergence towards resilient economic structures across the euro area ([81]).

II.6. Conclusion

This section aimed at better understanding the macroeconomic transmission mechanisms of the COVID-19 crisis. This may be helpful to support policy design going forward and in case of comparable events.

This section suggests that lockdown measures to limit the spread of the virus had a strong adverse impact on gross fixed capital formation across the euro area. The impact varied across countries and over time, partly reflecting cross-country differences in economic structure and gradual learning and adaptation by economic agents.

The strong rebound in investment in a context of very strong (and temporarily held back) demand, favourable financing conditions and supportive public investments ([82]) provides reasons for optimism. However, it is still too early to assess the long-term impact of the COVID-19 crisis on GFCF. Available evidence suggests, however, that much of the long-run damage initially feared might have been avoided thanks to the bold policy response at the height of the pandemic and the comprehensive recovery strategy that has ensued.

With the support of the NextGenerationEU (NGEU) instrument flanked by appropriate structural reforms, Member States have an opportunity to implement a comprehensive investment and reform agenda offsetting risks of divergence.

([75]) See Helmersson, T. et al. (2021), 'Corporate zombification: post-pandemic risks in the euro area', *ECB Financial Stability Review*, May 2021, Cros, M., A. Eupalard, P. Martin (2021), 'Will Schumpeter catch COVID-19? Evidence from France", VoxEU.

([76]) Eurostat (2021), Quarterly registrations of new businesses and declarations of bankruptcies - statistics.

([77]) Harasztosi, P., Maurin, L., Pál, R., Revoltella, D. and W. van der Wielen (2021), 'Policy support during the crisis: So far, so good?', paper presented at the EC Annual Research Conference 2021 making use of the 2021 vintage of the EIB Investment Survey (EIBIS) which contains a detailed set of questions regarding the nature of the policy support to firms during the Covid-19 crisis. They also report that there is no evidence that this support would have delayed the exit by firms that would otherwise have exited, even in the absence of crisis

([78]) On the accumulation of debt during the COVID-19 crisis in the Non Financial Corporations and related risks for investment decisions, see ECB (2021), *Financial Stability Review*, May.

([79]) Demmou, L., Calligaris, S., Franco, G., Dlugosch, D., Müge McGowan, A. and S. Sakha (2021), 'Insolvency and debt overhang following the COVID-19 outbreak: Assessment of risks and policy responses', *OECD Working Paper*, No. 1651.

([80]) Microsimulations by Bénassy-Quéré, A, B Hadjibeyli, G Roulleau, (2021), 'French firms through the COVID storm: Evidence from firm-level data', VoxEU suggest that in France the debt overhang caused by the crisis could reduce corporate investment by almost 2% during the recovery phase. However, the authors do not take into account the impact of the French recovery plan. Similar results are reported by Maurin, L. and R. Pál (2020), 'Investment vs debt trade-offs in the post-COVID-19 European economy', *EIB Working Paper*, no. 2020/09.

([81]) The global financial crisis already produced long-lasting consequences on investment, resulting in diverging paths in the accumulation of capital that have reduced the resilience of the euro area. See EU Commission, 2021 'Adjustment to large shocks in the euro area - insights from the COVID-19 pandemic', *Technical note for the Eurogroup*.

([82]) See European Commission (2021), *Autumn 2021 Economic Forecast*.