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Article

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Mirko Licchetta and Giovanni Mattozzi

Convergence in GDP per Capita in the Euro Area and the EU at the Time of COVID-19

This paper investigates determinants of convergence in GDP per capita in the euro area and the EU between 1995 and 2021. It finds that the COVID-19 crisis temporarily slowed convergence but the estimated negative impact is significantly smaller than during the global financial crisis. Diverging effects emerged linked to the timing of the pandemic, the tightness of lockdown measures and the importance of contact-intensive sectors in the economy, like tourism. However, the easing of lockdown measures coupled with policy support (including the successful vaccination strategy) mitigated the risks of a pandemic-driven persistent divergence in growth. Regression results provide further evidence of convergence in the euro area and the EU over the period 1995-2021 and highlight the slowdown in convergence since the global financial crisis, which can be mostly attributed both to a contraction in investment rates in converging countries and to the limited catch-up in total factor productivity growth, especially in euro area countries.

Convergence in standards of living is a concept that holds high economic, social and political relevance for citizens' well-being and is essential for European integration (Buti and Turrini, 2015). Large differences in GDP per capita of EU member states have persisted over time (Figure 1). In 1999, while northern countries enjoyed incomes higher than the EU average, incomes in southern and eastern countries were well below it. Contrasting developments in income per capita have occurred in the EU in the past few decades. On the one hand, most of the eastern countries have moved up vis-à-vis the EU average over that period. On the other hand, many northern and southern countries have only maintained their income positions or experienced a relative deterioration especially since the global financial crisis.

The asymmetric economic and social impact of the COVID-19 pandemic initially raised concerns of in-

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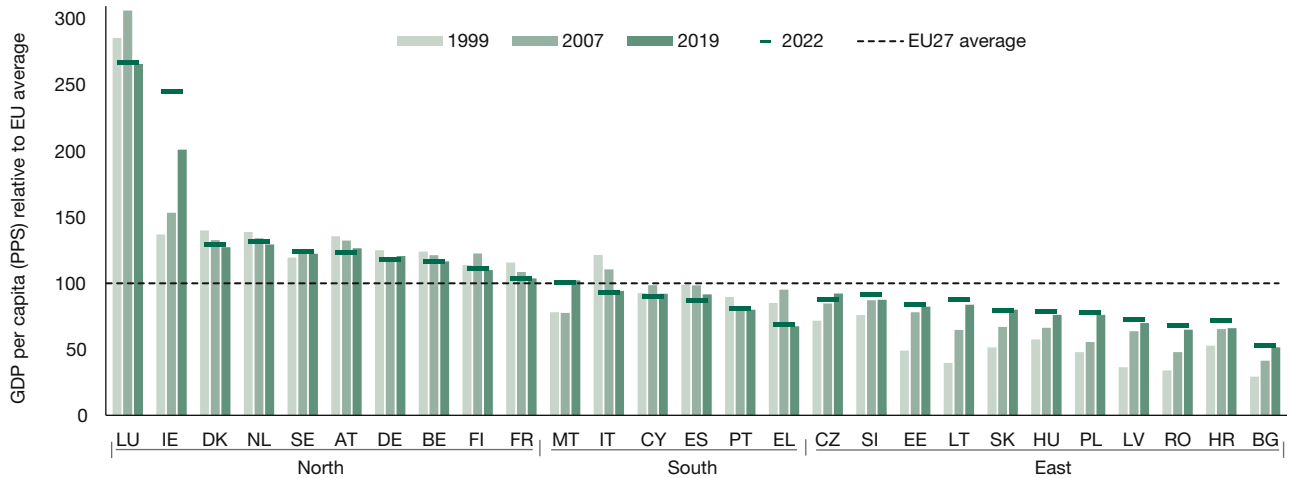
Giovanni Mattozzi, European Commission, Brussels, Belgium.

creased divergence in GDP per capita across member states, jeopardising the proper functioning and stability of the EU and ultimately reducing long-term growth prospects.¹ However, there is broad consensus that the bold and timely economic policy actions, along with the successful vaccination campaign, were effective in mitigating the economic impact of the crisis. They contributed to a faster recovery than initially expected in both the EU27 and the euro area (EA19), with quarterly GDP exceeding pre-pandemic levels already by the end of 2021.

This paper investigates determinants of convergence in GDP per capita, including the impact of the COVID-19 pandemic in the euro area and the EU.² Several studies have investigated the impact of the COVID-19 pandemic on economic activity³ but the impact on convergence in GDP per capita has received less attention. In order to assess developments in income per capita and conduct a comparative analysis between EU27, EA19 and EA12,

- 1 In the Commission's Autumn 2020 EU European Economic Forecast, GDP per capita for 2022 in all member states (excluding Greece) was expected to remain well below the 2019 level, and in Italy, Spain and Portugal it was forecast to fall by more than the euro area average.
- 2 Income convergence is defined in terms of GDP per capita. This study focuses on all European Union member states (EU27) and euro area countries (EA19) member states. EA12 includes the former euro area member states: Austria, Belgium, France, Finland, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain and Greece. New member states (NMS13) include Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia, Bulgaria, Romania and Croatia.
- 3 On the drivers of the COVID-19 impact on real GDP, see Sapir (2020), Chatelais (2021) and Licchetta and Meyermans (2022).

Figure 1
Income differences across EU member states since 1999



Note: Data on GDP per capita are expressed in constant prices and purchasing power standard (PPS) as a percentage of EU27 average GDP per capita in each year.

Source: AMECO, Spring 2022.

this article first focuses on sigma convergence and absolute (or unconditional) beta convergence. It then provides an econometric assessment of the pandemic's impact based on conditional beta convergence. The subsequent sections highlight the difference in the impact of the global financial crisis and COVID-19 crisis on income convergence, discuss the drivers of the slowdown in convergence since the global financial crisis and provide a robustness assessment of the central regression results. Finally, policy implications are also drawn.

Sigma convergence

The coefficient of variation of GDP per capita is a widely used measure of sigma convergence.⁴ In the period 1995 to 2019, the coefficient of variation decreased by around half in both EA19 and EU27, but the global financial crisis significantly slowed the pace of sigma convergence for both aggregates (Figure 2). By contrast, the COVID-19 crisis led to an increase in the coefficient of variation in the EU although the Commission Spring 2022 European Economic Forecast expected the increase to be temporary and for the downward trend to resume by 2022.

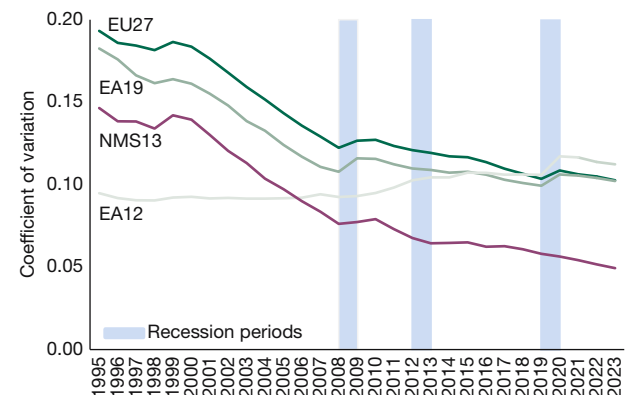
4 Sigma convergence relates to the cross-sectional dispersion of income, and it measures whether countries are becoming more similar in terms of the level and evolution of GDP per capita. A reduction indicates an increase in the economies' similarities. It is defined as the ratio of the standard deviation to the mean.

Absolute beta convergence

The global financial crisis and subsequent sovereign debt crisis proved detrimental to income convergence.⁵ Compared with 1995-2008, the absolute beta coefficient in the period 1995-2019 was about one-fifth lower in the EU27 and one-fourth smaller in the EA19 (Table 1). Results for EA12 point to an almost zero absolute convergence coefficient

5 Beta convergence implies that lower-income countries or regions tend to grow faster than richer ones. As opposed to sigma convergence, which refers to a reduction of disparities among regions over time, beta convergence focuses on detecting possible catch-up processes. Absolute beta convergence implies that all states or regions in a group will move to one steady state. For a review, see Temple (1999) and Durlauf et al. (2005).

Figure 2
Coefficient of variation of real GDP per capita (PPS)



Source: AMECO, Spring 2022.

Table 1
Absolute beta convergence

	1995-2008	1995-2012	1995-2019	1995-2021
EA19	-2.915*** (0.66)	-2.325*** (0.61)	-2.153*** (0.59)	-2.061*** (0.53)
EU27	-2.406*** (0.60)	-2.006*** (0.60)	-1.955*** (0.62)	-1.883*** (0.56)
EA12	-0.032 (0.00)	0.623 (0.08)	0.053 (0.00)	0.127 (0.00)
NMS13	-3.626*** (0.61)	-3.238*** (0.70)	-2.642*** (0.73)	-2.735*** (0.76)

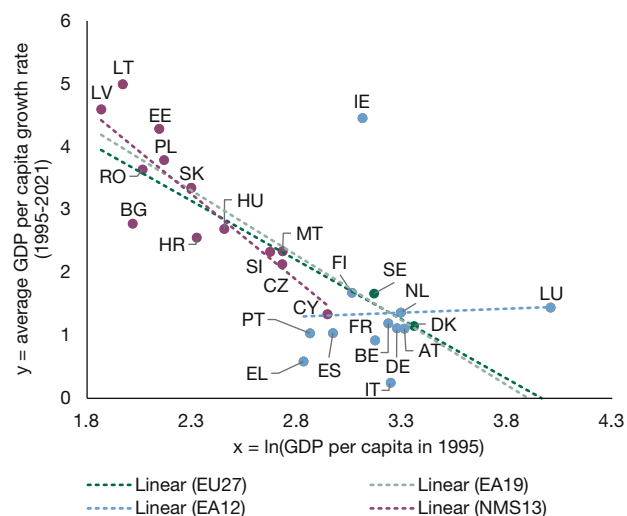
Notes: Absolute convergence is estimated through a cross-sectional country regression that relates the average annual growth rate of real GDP per capita in PPS over the indicated period and the initial level of GDP per capita. A negative absolute beta coefficient means convergence. Convergence increases with the absolute value of the coefficient. A positive value means lack of convergence. R squared in brackets. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Source: Authors' calculations and AMECO, Spring 2022.

prior to the global financial crisis and to a lack of convergence in the following period although results are not statistically significant.

The absolute beta convergence estimate suggests that the COVID-19 pandemic had little impact on the process of convergence (see also below). Indeed, the negative relationship between the log of GDP per capita in 1995 and the average GDP per capita growth between 1995 and 2021 supports the hypothesis of absolute convergence for EU27 and EA19. The slope of the curve in Figure 3

Figure 3
Absolute beta convergence in real GDP per capita (PPS)



Source: AMECO, Spring 2022.

measures the speed at which the gap with the steady state closes, the so-called speed of convergence. The absolute beta convergence coefficient among the EU27 and euro area has been around 2% over the 1995-2021 period. This is broadly consistent with the 2% “iron law” of convergence, which suggests that economies will converge at a common rate of 2% per year. In addition, as anticipated by the beta convergence process, a large majority of the countries that joined the EU after 2004 achieved a catch-up consistent with their lower initial levels of income per capita. This result emphasises that since 1995, poorer EU and euro area countries have exhibited faster growth than richer ones (ECB, 2015); this is consistent with the dynamics of productivity across euro area countries (Figure 4). On the other hand, there is a lack of statistically significant convergence within EA12.⁶

Conditional beta convergence

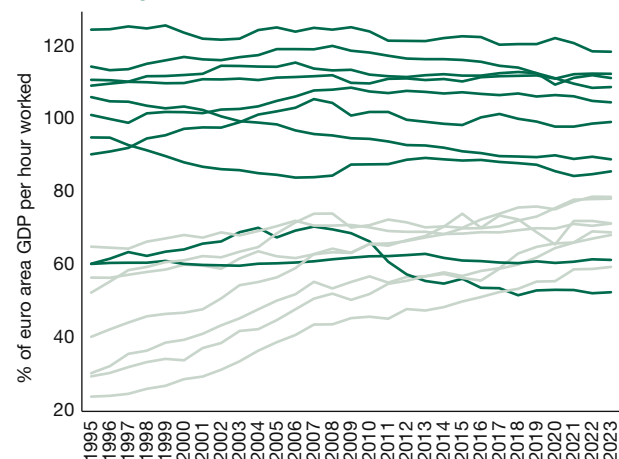
Modelling and explanatory variables

This paper estimates conditional beta convergence (Mankiw et al., 1992)⁷ for the euro area and the EU with panel regressions using annual data from 1995 to 2021. Following previous studies (e.g. Coutinho and Turrini, 2020) we estimate the following conditional beta convergence equation:

⁶ This is broadly unchanged under alternative starting points including from 1999 and 2000 (closer to the introduction of the euro).

⁷ Conditional beta convergence assumes that countries move to different steady-state growth rates that reflect various structural and institutional factors.

Figure 4
Productivity in euro area member states



Notes: GDP per hour worked in PPS and in percentage of EA19. The dark green lines refer to EA12 member states. The light green lines refer to member states joining the euro area after 2001. Luxembourg and Ireland are not included.

Source: AMECO, Spring 2022.

$$\Delta \ln Y_{it} = \alpha + \beta \ln Y_{it-1} + \gamma X_{it} + \varepsilon_{it}, \quad (1)$$

where Y_{it} is real GDP per capita; X_{it} is a set of quantitative (e.g. macroeconomic and institutional factors) and qualitative (e.g. dummy variables) control variables that condition convergence; i represents countries; t is the time period over which growth rate is computed and β is the measure of convergence. Macroeconomic data are from AMECO or Eurostat. To take account of the COVID-19 crisis, this paper relies on data on lockdown measures from Oxford University, tourism from the World Travel and Tourism Council, and vaccines from the European Centre for Disease Prevention and Control.

Several variables widely used in the growth literature were simultaneously estimated in the baseline convergence model, which reflects pooled ordinary least squares (OLS) with robust (clustered) standard errors to account for the heteroscedasticity and serial correlation between errors. Indicators that are not statistically and economically significant are manually deleted stepwise.⁸ The most parsimonious baseline model reflects the following widely used indicators:

Initial level of GDP per capita. Differences in macroeconomic and institutional factors across countries and time are taken into account. Low values of income per capita would be associated with higher growth rates in subsequent years.

Share of total investment in GDP. An increase in the share of gross fixed capital formation (GFCF) in GDP is expected to increase the capital share and the growth rate of GDP per capita. In the process of catching up, countries with lower levels of income per capita tend to accumulate capital at a faster rate.

Openness to trade. An increase in the sum of import plus export as a share of GDP suggests that open economies can borrow abroad and import technology and know-how that support total factor productivity growth and, more generally, gains from specialisation (Edwards, 1998; Frankel and Romer, 1999).

Proportion of early school leavers (as a share of the 18-24 population) is included as a proxy for human capital (Lucas, 1988)⁹ to account for investment in skills.

8 Some widely used indicators were tested but the results are neither statistically nor economically significant including proxies for institutional quality (e.g. the Economic Freedom Index from the Heritage Foundation), population growth, domestic credit, net capital stock (per unit of GDP) and Foreign Direct Investment (as a share of GDP).

9 Human capital has long been identified as a source of income convergence.

General government gross debt as a share of GDP. An increase in public debt could be associated with lower growth in GDP per capita over the longer term as public debt might detract resources from productive private investments. We would therefore expect a negative relationship between GDP per capita and public debt as a share of GDP over the long term.

The baseline model is augmented with the following variables related to COVID-19:

The Oxford Stringency Index is included to assess the impact of lockdown measures (Hale et al., 2020). Lockdown measures (along with voluntary social distancing) had a negative impact on GDP across member states, although it lessened over time so that the economic impact of the second lockdown was more contained than that of the first. The stringency indicator is interacted with the COVID-19 crisis dummy that equals 1 in 2020-2021.

The tourism sector as a share of GDP is used as a proxy for the relative size and economic importance of contact-intensive sectors.¹⁰ Member states with the largest shares of travel and tourism in their economies witnessed the steepest fall in GDP (Milesi-Ferretti, 2021). In the regression framework, this indicator is interacted with the COVID-19 crisis dummy.

Share of people vaccinated of the total population in 2020 and 2021 is included to provide an indication of the prospect of a return to more normal conditions. By the end of 2021, around 72% of the total population in the European Union had received at least one vaccine dose, although there were large differences within the EU. In the regression model, the share of people with at least one vaccine dose is interacted with the COVID-19 crisis dummy.

Empirical results

Table 2 reports regression results on the determinants of the real convergence represented by the annual growth of GDP per capita (in purchasing power standard, PPS). Column 1 shows the baseline model for the EA19 over the 1995-2019 pre-COVID-19 period. This model puts the growth rates of per capita real GDP in relation with other explanatory variables aiming at capturing drivers of growth in GDP per capita. In addition to the (lagged) initial income per capita, the estimated model confirms the beneficial influence of investment and trade in goods and services on income convergence. The investment variable may be a source of endogeneity in growth regressions as investments are also

10 In 2019, the contribution to GDP from the travel and tourism sector was 8.9% in France, 10.7% in Germany, 13.1% in Italy, 14.9% in Spain and 20.1% in Greece. See World Bank (2021) database.

Table 2
Conditional beta convergence estimates

Y: Change real GDP per capita (RGDP PC), PPS	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	EA19	EA19	EA19	EU27	EA19 ex	EA19 ex	EA19 ex	EA19 ex	EA19 ex	EA19 ex
	Base pre-COVID-19	Base all	Augm. all	Augm. all	GFC	COVID-19	Post-2008	Augm. all	Pre-GFC	Post-GFC
	1995-2019	1995-2021	1995-2021	1995-2021	1995-2021	1995-2021	1995-2021	1995-2021	1995-2007	2008-2021
RGDP PC (lagged)	-3.399***	-3.390***	-3.379***	-3.061***	-5.085***	-4.629***	-6.922***	-4.637***	-6.196***	-2.187**
GFCF (% of GDP)	0.194***	0.202***	0.206***	0.187***	0.204***	0.271***	0.149***	0.247***	0.319***	0.090
Openness to trade (% GDP)	0.014***	0.015***	0.015***	0.013***	0.010***	0.009***	0.010***	0.008***	0.005	0.015***
Early school leavers	-0.043*	-0.044*	-0.044**	-0.033*	-0.051***	-0.039**	-0.076***	-0.042**	-0.061***	-0.084**
Debt to GDP	-0.023***	-0.024***	-0.022***	-0.016**	-0.008	-0.009	0.034**	-0.012	0.015	0.039***
Share of tourism			-0.197**	-0.139	-0.152**	-0.140**	-0.190**	-0.135**		-0.211**
Stringency			-0.080***	-0.094***	-0.120***	-0.013	-0.113***	-0.108***		-0.113***
First dose (% of population)			0.158***	0.158***	0.162***	0.152***	0.157***	0.161***		0.156***
GFC dummy (2009-12=1)					-15.725***					
RGDP PC (lagged)* GFC dummy					3.839***					
COVID-19 dummy (2020-21=1)						2.583				
RGDP PC (lagged)* COVID-19 dummy						-2.257				
Post-2008 dummy (2008-21=1)							-17.673***			
RGDP PC(lag) * Post-2008 dummy							4.361***			
Constant	9.541***	9.261***	9.155***	8.043***	14.708***	11.281***	20.208***	12.021***	15.496***	1.739
Observations	428	466	466	645	417	417	417	417	179	238
R ²	0.23	0.20	0.38	0.35	0.55	0.44	0.51	0.43	0.63	0.45
Root mean squared error	3.15	3.54	3.13	3.08	2.60	3.13	2.69	2.90	1.61	3.10

Notes: * p<0.10; **p<0.05; *** p<0.01. GFC: global financial crisis, GFCF: gross fixed capital formation, ex: GDP data for Ireland and Luxembourg are distorted by the presence of large multinationals or large financial sectors. In columns 5-10, the beta convergence equation has been re-estimated excluding Ireland and Luxembourg. Regression results are qualitatively unchanged in this smaller sample.

Source: Authors' calculations.

influenced by expected growth rates. However, there was no evidence of endogeneity in this indicator in our sample. At the same time, an increase in public debt is associated with lower growth in GDP per capita over the long term,¹¹ although this result should be interpreted with care as causality could go in both directions (see, for example, Heimberger, 2021; and Pescatori et al., 2014). Finally, in column 2, the base model is extended to cover the COVID-19 crisis period (2020-2021) and it remains broadly unchanged, suggesting stability of the estimated convergence path.

The baseline model is augmented with COVID-19 variables, and results are shown in Table 2 (column 3) for the EA19 and (column 4) for the EU27. As expected, the intro-

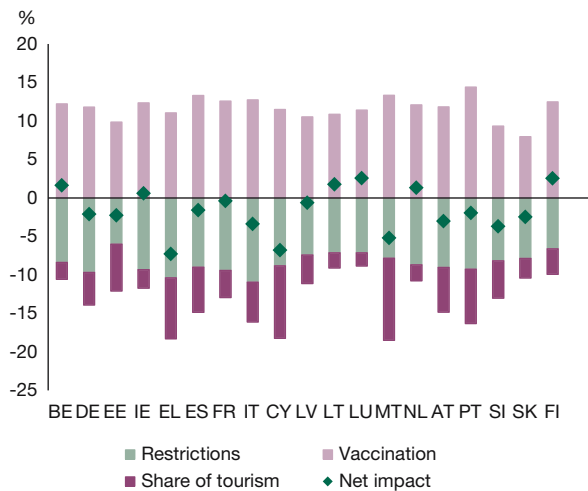
11 Coutinho and Turrini (2020) also find that reducing government debt would reduce the convergence gap. See also Chudik et al. (2013).

duction of lockdown measures to curb the spread of the virus lowered the growth in GDP per capita.¹² The negative impact of the lockdown measures increased with the size of the tourism sector, a labour-intensive sector characterised by face-to-face interactions and severely hit by border closures. On the other hand, growth in GDP per capita increased with the rollout of the successful vaccination strategy, providing evidence that it supported the recovery by facilitating the re-opening of the economy.¹³

12 The stringency index is statistically significant in 2020 but not in 2021 when included for the two single years separately. This is consistent with the more contained economic impact in 2021.

13 An IMF study on a large sample found that vaccines are statistically associated with variables related to the re-opening of the economy, such as NO₂ emissions and mobility. Nevertheless, the impact of vaccines is more muted in those countries experiencing high stringency of lockdowns and large waves of COVID-19 cases. See Deb et al. (2021).

Figure 5
Cumulative marginal impacts (2020 and 2021) on annual growth in GDP per capita in the euro area, COVID-19 regressors



Note: Marginal impacts calculated with equation 3 in Table 2.

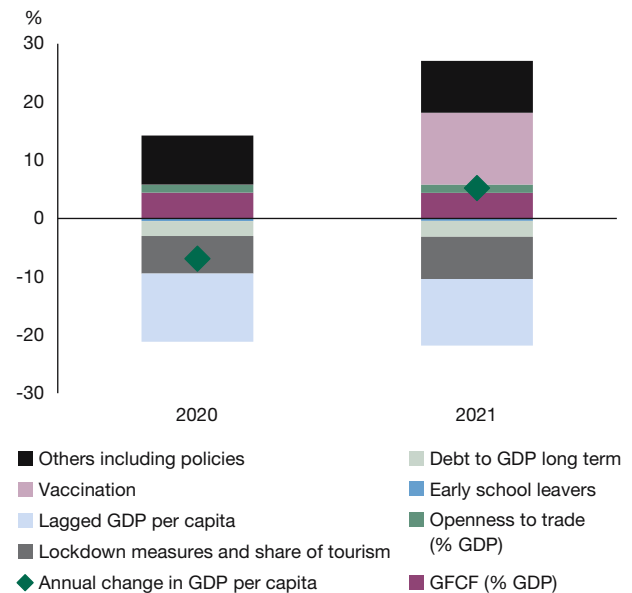
Source: Authors' calculations.

Figure 5 highlights the estimated cumulative marginal impacts and illustrates how the estimated positive impact of vaccination strategy offsets (at least partially) in most countries the negative economic impacts of the government restrictions on the economy that are of relevance for those member states that rely more on tourism (as measured by the share of tourism in GDP). Findings in this area are broadly consistent with recent evidence on the short-term impact of COVID-19. Finally, Figure 6 provides an overview of the contribution of estimated determinants.

Impact of the COVID-19 crisis on income convergence

The COVID-19 crisis had a negative impact on convergence in the EA19, although such an impact is expected to be more temporary and less sizeable than following the global financial crisis. This might be due to the very different nature of the COVID-19 and the global financial crises and the different policy responses. The global financial crisis originated from macro-financial imbalances that had built up for years, requiring a long-lasting adjustment by households and governments. By contrast, COVID-19 was a major exogenous shock resulting from a health emergency, the effects of which were mitigated by governments. Given the policy support for households and firms affected by the lockdown, once restrictions on mobility were lifted, the economy rebounded quickly.

Figure 6
Breakdown of the annual changes in GDP per capita in the euro area during COVID-19



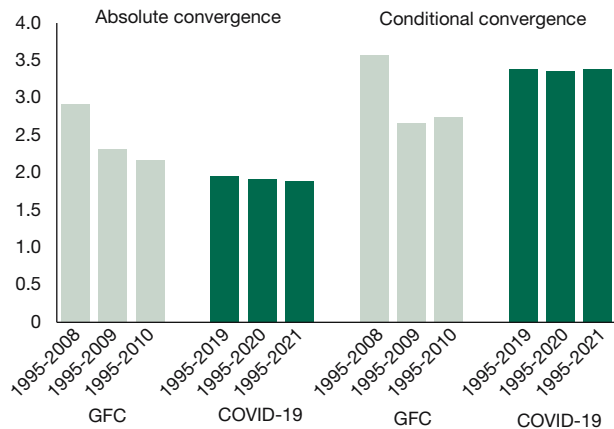
Notes: Marginal impacts calculated with equation 3 in Table 2. GFCF stands for gross fixed capital formation.

Source: Authors' calculations.

Despite the deeper drop in GDP, we find evidence of a less sizeable impact on income convergence of the COVID-19 crisis compared to the global financial crisis. The estimated absolute and conditional beta convergence coefficients for the EA19 remained broadly unchanged following the COVID-19 shock (Figure 7). This suggests that the policy response to COVID-19 at the EU and national level mitigated the negative economic impact. By contrast, the estimated beta coefficient decreased significantly following the global financial crisis, suggesting a longer-lasting impact. One important caveat is that the full impact of the COVID-19 crisis might not have fully played out yet although the evidence available points to lower long-term damages than following the global financial crisis.

Regression results in Table 2 (columns 5-7) provide evidence that the global financial crisis has had a more long-lasting negative impact on conditional beta convergence than the COVID-19 crisis. First, there is a positive and statistically significant interaction (column 5) between the level of GDP per capita (lagged) and a global financial crisis dummy (equal to 1 over the 2009-12 period). A structural break following the global financial crisis (with a dummy equal to 1 from 2008 onwards) is also supported in the data suggesting that the global financial crisis slowed down the annual growth of GDP per capita over

Figure 7
Beta coefficient estimates (absolute value)



Notes: GFC stands for global financial crisis. Results are for the EA19 sub-sample, but they are qualitatively unchanged for the EU27. Absolute beta convergence estimates from Table 1. Conditional beta convergence results are based on the equation in column 3 in Table 2.

Source: Authors' calculations.

a lasting period (column 7). By contrast, results for the COVID-19 period are not statistically significant (column 6) suggesting that convergence might have been little affected by the pandemic.

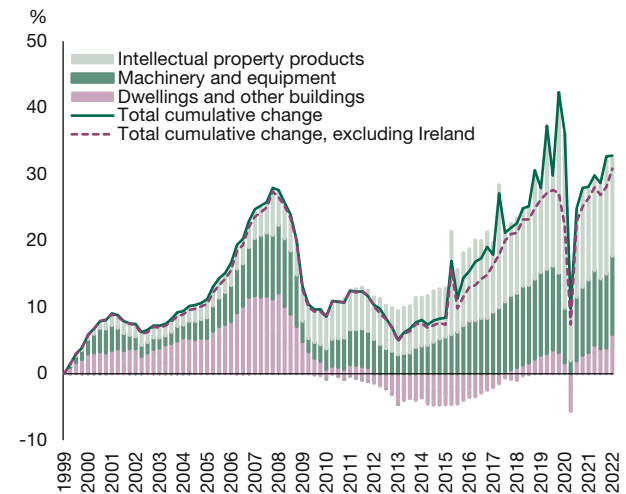
Drivers of the slowdown in convergence after the global financial crisis

Income convergence in the euro area slowed significantly following the global financial crisis. The estimated conditional beta coefficient is significantly smaller in the post-2007 period (see columns 8-10 in Table 2 for the EA19 subsample excluding Ireland and Luxembourg). The significant fall in investment rates of many converging countries in the period following the global financial crisis contributed to the observed slowdown in convergence. In particular, capital accumulation was sluggish in the euro area in the decade following the global financial crisis (Figure 8), and GFCF took about ten years to return to its pre-crisis level.¹⁴ Indeed, there is preliminary regression evidence that the contribution of GFCF declined after the global financial crisis. In this shorter subsample, the GFCF indicator is still positive, but it is smaller, and it loses its statistical significance (see column 9-10 in Table 2).¹⁵ This result might suggest that after 2008, the

14 When Irish data are excluded, GFCF recovered its pre-COVID-19 level within two years. See also Licchetta and Meyermans (2022).

15 However, the number of observations is considerably smaller in this subsample starting in 2008, leaving fewer degrees of freedom for the estimation. So results are only indicative and inference from this subsample should be viewed with caution.

Figure 8
Cumulative change in gross fixed capital formation in the euro area since 1999



Source: Eurostat.

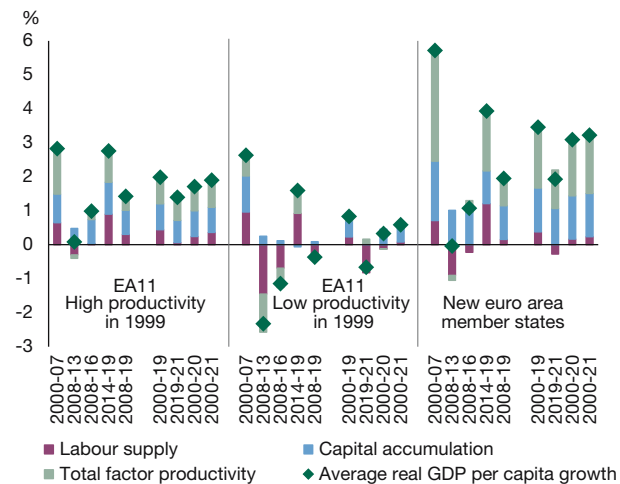
neoclassical convergence channel has not been fully in play because growth in GFCF after 2008 was relatively weak to support growth. By contrast, in the period before 2008, growth in GFCF was higher in many converging countries.¹⁶ The interaction between the investment indicator and the lagged GDP per capita was also tested but it was not statistically significant in most regressions (including when residential constructions were excluded).

The lull in convergence following the global financial crisis might also be related to the more pronounced slowdown in the growth of total factor productivity (TFP), a key driver of income convergence (Figure 9). Limited productivity catch-up, in particular a progressive reduction in TFP growth, is a key driver for the lack of convergence of some of the early members of the euro area (Greece, Portugal, Spain and Italy).¹⁷ Euro area countries with both high and low labour productivity levels (defined according to real GDP per hour worked in 1999) have experienced a slowdown in TFP growth over recent decades (Figure 9). However, the countries with low initial productivity experi-

16 Over the 1996-2007 period, many member states that joined the euro area after 2004 experienced higher growth in GFCF than the older member states. For example, the Baltic countries saw their GFCF increasing up to seven times faster than the entire euro area aggregate. Following the global financial crisis, GFCF decreased or stagnated in most member states. Even in the countries where it increased, growth in GFCF has been consistently lower than in the period 1996-2007.

17 Some of these early members experienced substantial capital inflows in the first decade of the euro that fuelled unsustainable credit booms in consumption and real estate rather than boosting productivity. See Diaz del Hoyo et al. (2017) and IMF (2017).

Figure 9
Decomposition of average annual GDP growth in the euro area



Note: Luxembourg is excluded.

Source: AMECO and authors' calculations.

enced consistently lower TFP growth throughout the sample period and a more pronounced slowdown during the global financial crisis. TFP growth in the euro area, which was already low before the global financial crisis, has

worsened since then. At the same time, TFP growth was the key driver of post-accession growth in the countries that joined the euro area after 2007. Differences across countries, and regions, are also stark in some cases.

Robustness tests

Several tests have been performed to assess the robustness of the central results of this paper (Table 3). The most notable findings are as follows.

The baseline model (column 1) is estimated using annual data. Focusing on such a short period, there is a risk of capturing some cyclical aspects. However, results are broadly unchanged when: first, following standard practice in the estimation of growth regressions with panel data, annual observations are converted into averages over non-overlapping, five-year sub-periods to reduce the effects of cyclical disturbances on the results (column 2);¹⁸ second, initial conditions are lagged by two

¹⁸ Because of the Russian invasion of Ukraine and its notable negative economic impacts, an assessment of the impact of COVID-19 on income convergence should concentrate exclusively on 2020 and 2021. While using annual data, we make the comparison with the global financial crisis as meaningful as possible by focusing on the two years immediately after the beginning of the two events.

Table 3
Robustness checks (1995-2021)

Y: Change in real GDP per capita (RGDP PC), PPS	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Base	Base 5y not overlap average	Y: Change in RGDP PC (T=2)	Y: Change in RGDP PC (not PPS)	Augmented model	GFCF ex-dwellings	Pooled OLS Driscoll-Kraay	PCSE GLS	Panel GLS	Random effects panel GLS
RGDP PC PPS (lag)	-3.390***	-2.807***	-3.212***	-1.978***	-3.379***	-2.949***	-3.379***	-3.791***	-3.842***	-3.664***
GFCF (% of GDP)	0.202***	0.206**	0.257***	0.201***	0.206***		0.206***	0.190***	0.170***	0.214***
Openness to trade (% GDP)	0.015***	0.013***	0.014***	0.012***	0.015***	0.012***	0.015***	0.016***	0.015***	0.015***
Early school leavers	-0.044*	-0.042*	-0.038*	-0.043**	-0.044**	-0.030	-0.044*	-0.045**	-0.043**	-0.044**
Debt to GDP (%)	-0.024***	-0.022***	-0.029***	-0.026***	-0.022***	-0.024***	-0.022**	-0.024***	-0.022***	-0.022***
Share of tourism					-0.197**	-0.184**	-0.197***	-0.228**	-0.176**	-0.188**
Stringency					-0.080***	-0.083***	-0.080***	-0.076***	-0.110***	-0.082***
First dose (% of population)					0.158***	0.159***	0.158***	0.161***	0.169***	0.158***
GFCF (ex. dwellings) (% of GDP)						0.217***				
Constant	9.261***	7.115**	7.787***	5.083***	9.155***	8.792***	9.155***	10.737***	11.382***	9.764***
Observations	466	95	466	466	466	466	466	466	466	466
R ²	0.20	0.47	0.39	0.18	0.38	0.38	0.38	0.40		
Root mean squared error	3.53	1.99	2.47	3.57	3.12	3.12	3.12	2.92		3.10

Notes: GFCF stands for gross fixed capital formation. PCSE stands for panel-corrected standard errors.

Source: Authors' elaboration.

years (column 3), rather than one year as in the base model (column 1); and third, the dependent variable is real GDP per capita not in PPS (column 4).

The augmented model (column 5) is estimated with pooled OLS with robust (clustered) standard errors and it is qualitatively unchanged when the GFCF variable excludes dwellings (column 6). Moreover, we could not find proof of endogeneity for the investment indicator.¹⁹

Finally, the inclusion of lagged variables within a panel framework raises additional risks of endogeneity and autocorrelation but we found that our results are broadly stable when spatial correlation consistent standard errors are computed (column 7) or generalised least squares coefficient estimates with panel corrected standard errors are adopted (column 8–9) or under the random effect estimator (column 10).²⁰

Conclusions and implications for policy

The COVID-19 crisis was like no other and had more severe consequences for countries with more contact-intensive sectors. Some of the most affected economies already experienced below EU average per capita income levels in 2019. At the same time, there were great concerns that the COVID-19 shock could further reduce the degree of convergence across the EU and lead to further divergences. The preliminary evidence provided in this paper, however, suggests that the COVID-19 shock is likely to have been significantly less damaging to the convergence process than the global financial crisis. Some of the channels that played out after the global financial crisis were probably not in play during the COVID-19 crisis.

Regression results provide further evidence for the growth-enhancing role of trade, as well as physical and human capital. The latter driver of growth is particu-

larly relevant in the context of the unprecedented skill shortages that emerged during the recovery from the COVID-19 crisis. The importance of human capital as a driver of growth also highlights the key role of skill policies in addressing the root causes of labour shortages. Finally, this paper further stresses the need to continue tackling structural economic weaknesses through investments and reforms needed to improve productivity growth, a main driver for income convergence.

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19 We use the endogeneity test for explanatory variables (endog) implemented by the Stata command `xtivreg2`. Under the null hypothesis of exogeneity, the chi-squared p-value for investment was 0.4250 in the model with fixed effects. Therefore, it cannot be rejected the null hypothesis that investment can be treated as exogenous in this sample. See also Baum et al. (2003). The investment indicator remains positive and statistically significant when the model is re-estimated with IV and GMM using the inflation deflator as an instrument (not shown in the table). Finally, results are broadly unchanged when the investment deflator is used as an instrument for the investment indicator delivering the expected negative sign and significant coefficients while the other regressors are qualitatively unchanged.

20 The inclusion of country fixed effects was also tested while favouring random effects. This is consistent with Bell and Jones (2015), who show that in the context of macroeconomic panels (as opposed to microeconomic panels), the more parsimonious random effect model is often superior to the fixed effects model.