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The **Quarterly Report on the Euro Area** is written by staff of the Directorate-General for Economic and Financial Affairs. It is intended to contribute to a better understanding of economic developments in the euro area and to improve the quality of the public debate surrounding the area's economic policy.

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The views expressed are the author's alone and do not necessarily correspond to those of the European Commission.

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Directorate-General for Economic and Financial Affairs

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Boxes

With inflation reaching unprecedented levels since the launch of the euro, euro-area citizens are experiencing sharp rises in the cost of living. At the same time, persistent geopolitical tensions at the borders of the euro area and strict pandemic containment measures in major trading partners are aggravating the already high levels of uncertainty. This hinders the supply of natural resources and curtails economic activity worldwide. Our upcoming forecasts, to be published on 11 November, will provide a full assessment of these developments on growth and inflation.

This Quarterly Report on the Euro Area (QREA) focusses on topics that complement the Commission's work on the immediate economic impact of the war in Ukraine as extensively discussed in the latest and upcoming Commission economic forecasts. More specifically, this report assesses the impact of the COVID-19 pandemic on income convergence as measured in terms of growth in real GDP per capita. It also sheds light on the links between the housing market and the real economy across the euro area, and compares the intensity of the pass-through of exchange rate changes to import prices. The key considerations underpinning the Council's final approval for Croatia to become the 20th member of the euro area are briefly discussed in the last section. The report closes with the recurrent euro area chronicle.

Taking into account other structural factors such as the legacy of the global financial crisis, available evidence suggests that the COVID-19 pandemic temporarily slowed down income convergence in the euro area and the EU. However, this slowdown is likely to be significantly less persistent than during the global financial crisis. While divergences in the tightness of lockdown measures and in the size of contact-intensive sectors hindered convergence in the short term, the subsequent easing of the lockdown measures and policy support seem to have mitigated the risk of pandemic-driven divergence. This stands in sharp contrast to the slowdown in convergence in the wake of the global financial crisis, which proved very persistent. The preliminary conclusion that the COVID-19 crisis is unlikely to leave deep scars in the euro area's real convergence process is good news. However, the excessive surge in energy prices since the Russian invasion of Ukraine is affecting Member States unequally and could put the regained upward convergence at risk.

Housing represents a large share of household wealth and housing market developments have important feedbacks on overall economic activity in the euro area and across its members. Section 2 shows that there are significant links between housing market developments and the real economy at the euro area level but also that the strength of these links depends, in part, on the housing supply elasticity, which is determined by diverse country-specific factors, most notably land-use regulation and building regulation. The analysis also confirms the efficiency of macroprudential tools, namely borrower-based measures, both on house prices and mortgage credit with limited collateral effect on economic activity. It is too early to gauge the full impact of the current crisis on housing markets in the euro area countries. Nevertheless, the analysis is particularly relevant as it once again underlines the relevance of house supply constraints, which are likely to persist.

On the external side, the intensity of the pass-through of changes in the exchange rate to import prices has a direct impact on Member State inflation and on external adjustment capacity, and thus also indirectly on convergence. Estimates of short- and long-run pass-through suggest that the size of the pass-through differs significantly across currencies within Member States and between Member States. While not covering the most recent exchange rate developments, the analysis points to the possibility that the recent dollar appreciation may significantly raise import price inflation across the euro area.

The latest assessment of the convergence progress made by non-euro area Member States found that Croatia was the only Member State to fulfil all convergence criteria. This assessment paved the way for the Council's final approval for Croatia to become the 20th member of the euro area. Section 4 presents the key economic considerations underpinning that positive assessment.

The euro area thus remains an attractive monetary union to join. To further improve its functioning and to address the socio-economic fallout of the current geopolitical tensions and the pandemic, we have to strengthen Member States' economic fundamentals and resilience, better coordinate national economic policies and speed up the green and digital transitions.

I. Convergence in GDP per capita in the euro area and the EU at the time of COVID-19

By Mirko Licchetta and Giovanni Mattozzi

***Abstract**: This paper investigates determinants of convergence in GDP per capita in the euro area and the EU between 1995 and 2021 including the impact of the COVID-19 crisis. 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 the speed of convergence following the global financial crisis. It finds that this slowdown can, in most part, be 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. Finally, the estimated model highlights the importance of traditional macroeconomic variables for income convergence and it confirms, in particular, the beneficial influence of investment in physical and human capital and trade in goods and services.*

I.1. Introduction

Convergence in standards of living is a concept that holds high economic, social and political relevance for citizens' wellbeing ([1]) and is essential for European integration. In line with the European treaties, EU policies have been put in place to favour economic, social and territorial cohesion. In political terms, there are reasons to speculate that persistent divergences in economic outcomes or even a mere stagnation of convergence might generate political tensions. This is particularly the case when countries and regions are perceived as being left behind, i.e. neither contributing to, nor benefiting from, innovation and economic progress.

Large differences in GDP per capita of EU Member States have persisted over time (Graph I.1). In 1999, while northern countries enjoyed incomes higher than the EU average, incomes in southern and eastern countries, were well below the average. Contrasting developments in income per capita have occurred in the EU in the last 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 increased divergence in GDP per capita across Member States, jeopardising the proper functioning and stability of the EU and ultimately reducing long-term growth prospects ([2]). 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 EU-27 and in the EA-19, with quarterly GDP exceeding pre-pandemic levels already by the end of 2021 ([3]).

In this context, and with a view to drawing possible policy lessons going forward, 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 ([4]).

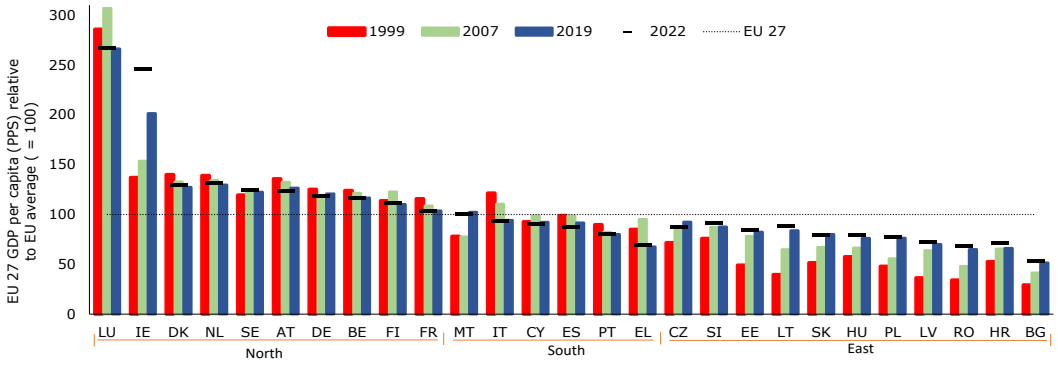
([1]) See Buti, M. and A. Turrini (2015), Three waves of convergence. Can Eurozone countries start growing together again?, 17 April VoxEU.

([2]) 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 Italy, Spain and Portugal were forecast to fall by more than the euro area average.

([3]) See European Commission (2021), *European Economic Forecast – Autumn 2021*. Following the global financial crisis, the sovereign debt crisis in the euro area slowed down the recovery so that the level of GDP took about 7 years to exceed the 2008 level.

([4]) Income convergence is defined in terms of GDP per capita. This study focuses on all European Union Member States (EU-27) and euro area countries (EA-19) Member States respectively. EA12 includes the former euro area Member States (Austria, Belgium, France, Finland, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain and Greece). New Member States (NMS-13) includes Cyprus, Czechia, Estonia, Hungary, Latvia,

Graph I.1: **Income differences across Member States since 1999**



(1) Data on GDP per capita are expressed in constant prices and purchasing power standard (PPS), as a percentage of GDP per capita in the EU-27 in each year.

(2) GDP per capita for Ireland and Luxembourg should be carefully interpreted. The notably higher-than-average GDP per capita in Luxembourg is due to of the many foreign residents employed in the country and thus contributing to its GDP, while they are not part of Luxembourg's resident population. As for Ireland, the high level of GDP per capita is partly due to the high GDP level related to the presence of large multinational companies holding intellectual properties.

Source: AMECO (Spring 2022 Vintage).

This paper provides several contributions to existing literature. First, using absolute and conditional beta-convergence and sigma-convergence indicators from 1995 to 2021 (see below for explanations of the two forms of convergence), this paper finds that the COVID-19 crisis temporarily slowed the process of convergence across the euro area and the EU. Nevertheless, the estimated impact is smaller than following the global financial crisis. Second, this paper takes stock of developments in convergence in GDP per capita. It takes a long historical perspective and include the period 2020-2021 thereby encompassing the COVID-19 crisis ([5]). In this longer sample, there is evidence for absolute and conditional beta-convergence for both EU-27 and EA-19 over the 1995-2021 period whereas there is a lack of convergence for the EA-12 (the eleven founding members of the euro area plus Greece). Third, this paper provides further evidence of the slowdown in income convergence following the global financial crisis. This is likely to be partly associated with a contraction in investment rates in converging countries. Limited catch-up in total factor productivity growth between euro area countries might have also contributed. Finally, it provides evidence of the impact of a standard set of macroeconomic variables on income convergence.

The structure of this paper is as follows. To assess developments in income per capita and conduct comparative analysis between EU-27, EA-19 and EA-12, the second subsection focuses on sigma convergence and the third section focuses on absolute or unconditional beta-convergence. The fourth subsection provides an econometric assessment of the pandemic's impact based on conditional beta-convergence. The fifth and sixth sections highlight the difference in the impact of the global financial crisis and COVID-19 crisis on income convergence and discuss the drivers of the slowdown in convergence since the global financial crisis. Finally, some policy implications are drawn from the analysis.

I.2. Sigma-convergence

The coefficient of variation of GDP per capita is a widely used measure of sigma convergence ([6]). In the period 1995 to2019, the coefficient of variation decreased by around half in both EA-19 and EU-27 but the global financial crisis significantly slowed down the pace of sigma-convergence for both aggregates (Graph I.2). Within the EU-27, the decline in income disparities was particularly strong

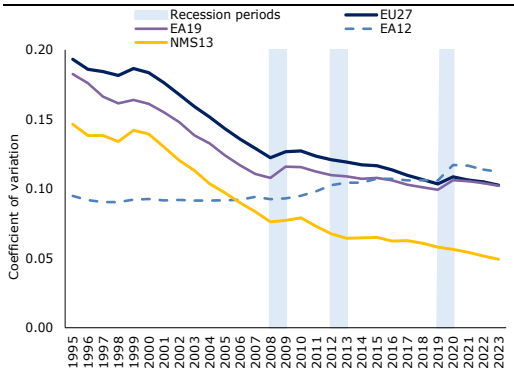
Lithuania, Malta, Poland, Slovakia, Slovenia, Bulgaria, Romania, Croatia.

([5]) It complements 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.

([6]) Sigma-convergence relates to the cross-sectional dispersion of income and it measures if 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.

in the NMS-13, which experienced the largest fall since 1999. As for the EA-12, income disparities were stagnant before the global financial crisis and widened somewhat after it. 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. (7)

Graph I.2: **Coefficient of variation of real GDP per capita (PPS)**



Source: AMECO (Spring 2022 Vintage).

I.3. Absolute beta-convergence

Beta-convergence is inspired by the neoclassical growth model. It assumes diminishing returns to capital. It implies that lower-income countries or regions tend to grow faster than richer ones. From this perspective, initially poorer economies with lower capital stock experience higher growth rates than developed economies due to the higher return on capital. 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 (8). This is the case for homogenous country groups or group of regions. However, economies differ on a variety of structural and institutional features. As a result, countries and regions may converge to different steady states, consistent with the "conditional" beta convergence hypothesis.

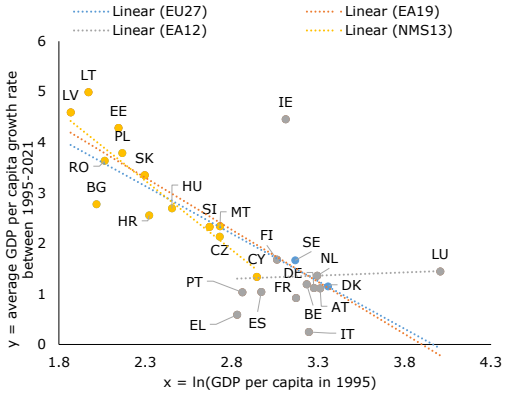
Table I.1: **Absolute beta convergence**

	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)

(1) 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. (2) 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 is reported in brackets.

* p<0.10; **p<0.05; *** p<0.01.
Source: Author's calculations and AMECO (Spring 2022 Vintage).

Graph I.3: **Absolute beta convergence (1995-2021) in real GDP per capita (PPS)**



Source: AMECO (Spring 2022 Vintage).

The global financial crisis and subsequent sovereign debt crisis proved detrimental for income convergence. Compared with 1995-2008, the absolute beta coefficient in the period 2008-2019 was about one fifth lower in the EU-27 and one quarter smaller in the EA-19 (Table I.1) (9) (10). Results for EA-12 point to an almost zero absolute convergence coefficient prior to the global financial crisis and to a lack of convergence in the

(7) The increase was larger in EA-19 and EA12 (6.5% and 10% respectively) than in EU-27 (3.4%) although it was slightly lower than in the aftermath of the global financial crisis, especially in EU-27 and EA-19.

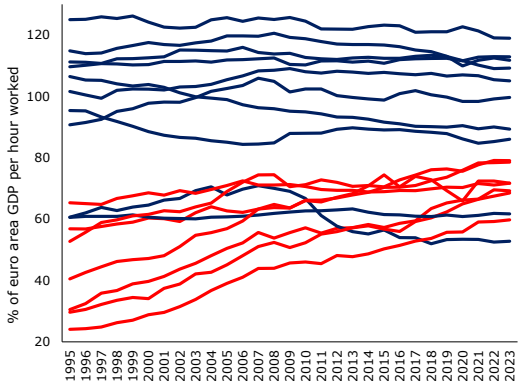
(8) See Temple (1999), *The New Growth Evidence*, Journal of Economic Literature, Vol 37, No1 March 1999 (pp. 112-156) and Durlauf, SN, P.A. Johnson and J.R.W. Temple (2005), *Growth Econometrics*, Chapter 08 in Handbook of Economic Growth, 2005, vol. 1, Part A, pp 555-677.

(9) NMS13 experienced a decrease in the degree of the convergence coefficient in line with the decrease experienced by EU-27 although the New Member States still faced a much higher level of convergence both before and after the global financial crisis.

(10) The 1995-2008 period is highly heterogeneous in terms of economic regime for the EU-27 and EA-19 aggregates as some countries only joined the EU in 2004. For many of these countries the early part of the sample has been characterised by a difficult transition from a planned economy regime.

following period although results are not statistically significant ([11]).

Graph I.4: **Productivity in euro area Member States**



(1) GDP in per hour worked in PPS and in percentage of EA-19. The blue refers to EA-12 Member States. The red lines refer to Member States joining the euro area after 2001. Luxembourg and Ireland are not included

Source: AMECO (2022 Spring Vintage).

Absolute beta convergence estimate suggests that COVID-19 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 EU-27 and EA-19. The slope of the curve in Graph I.3 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 EU-27 and euro area has been around 2% over the 1995-21 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 ([12]);it is consistent with the dynamics of productivity across euro area countries (Graph I.4). On the other hand, there is lack of convergence for EA-12, albeit the results are not statistically significant ([13]).

I.4. Conditional beta-convergence

Conditional beta-convergence assumes that countries move to different steady-state growth rates that reflect various structural and institutional factors. The drivers of income convergence were originally analysed under the lenses of the neoclassical Solow growth model. An augmented version of the Solow model including physical capital accumulation, human capital accumulation and population growth found that these drivers explained about 80% of international differences in standards of living ([14]). However, technical change remained exogenous in such models. With the endogenous growth literature, technical change has become endogenous and policy-relevant factors, such as human capital ([15]), R&D&I, trade openness ([16]) and institutional quality have been put forward.

I.4.1. Explanatory variables

We estimate a set of beta conditional regressions to assess the determinants of GDP per capita convergence in the euro area and the EU including the impact of COVID-19 (Box I.1 provides details on the modelling approach). Several studies have investigated the impact of the COVID-19 pandemic on economic activity ([17]) but the impact

([11]) Regional data based on ARDECO point to a similar decline in the pace of beta convergence in the EU-27 after the global financial crisis. However, the impact appears smaller than when using country level data.

([12]) See ECB (2015), Real convergence in the euro area: evidence, theory and policy implications, Economic Bulletin, Issue 5/2015.

([13]) The central results are broadly unchanged under alternative starting points including from 1999 and 2000 (closer to the introduction of the euro) and with regional ARDECO data.

([14]) Mankiw G., Romer P. and Weil D. (1992), *A Contribution to the Empirics of Economic Growth,* The Quarterly Journal of Economics.

([15]) Hall R. and Jones C. (1999),*Why do Some Countries Produce So Much More Output Per Worker than Others?,* The Quarterly Journal of Economics, Oxford University Press.

([16]) Sachs J. and Warner A. (1995), *Economic Convergence and Economic Policies*, NBER WP No. 5039 and Ben-David, D. (1996), *Trade and Convergence among Countries*, Journal of International Economies.

([17]) On the drivers of the COVID-19 impact on real GDP, Sapir (2020) finds that lockdown measures, the share of tourism and the quality of institutions prior to the crisis helped explaining the differential impact across the EU. Chatelais (2021) estimates that differences in the degree of containment measures along with the structure of the economy (such as the size of tourism and the technological development) can account for most of the 2020 GDP contraction in Europe. Sapir, A. (2020), 'Why has COVID-19 hit different European Union economies so differently', Bruegel Policy Contribution Issue n°18 and Chatelais, N. (2021), *Covid-19 and divergence in GDP declines between Europe and the United States*. See also Licchetta M. and Meyermans E. (2022), *Gross fixed capital formation in the euro area during the COVID-19 pandemic*, Quarterly Report on the Euro Area (QREA), vol. 20(4), and Meyermans, E, Rutkauskas, V. and Simons, W (2021), *The uneven impact of the COVID-19 pandemic across the euro area,* QREA, vol. 20(2).

on convergence in GDP per capita has received less attention so far ([18]). The most parsimonious baseline model reflects the following widely used indicators ([19]):

- Initial level of GDP per capita: taking into account differences in macroeconomic and institutional factors across countries and time: 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. ([20])

- 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 supporting total factor productivity growth and more generically gains from specialisation. ([21])

- Proportion of early school leavers (as a share of the 18-24 population): to proxy for human capital ([22]) to account for investment in skills.

- General government gross debt (as a share of GDP): an increase in public debt could be associated to lower growth in GDP per capita over the longer-term as public debt might detract resources from more productive private investment opportunities. We would therefore expect a negative relationship between GDP per capita and the share of 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: to assess the impact of lockdown measures ([23]). 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: proxy for the relative size and economic importance of contact intensive sectors ([24]). Member States with the largest shares of travel and tourism in their economies witnessed the steepest fall in GDP ([25]). 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: 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.

I.4.2. Empirical results

A set of parsimonious conditional beta equations to assess the determinants of the real convergence

([18]) Focusing on a global dataset, Brussevich et al. (2022) found divergence in per-capita income during the COVID-19 recovery, with countries at the bottom of the income distribution falling significantly behind. The authors highlighted that higher vaccination rates and targeted containment measures were associated with a faster recovery. Brussevich, M., Liu, S. and Papageorgiou, C. (2022), *Income convergence or divergence in the aftermath of the COVID-19 shock*, IMF WP 2022/121.

([19]) Some widely used indicators were tested but resulted not statistically or economically significant. They included 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), Foreign Direct Investment (as a share of GDP) and inflation rate.

([20]) However, this has not been always the case for example in Spain prior to the global financial crisis when there was an accumulation of investment in non-tradables that proved to be unsustainable.

([21]) See Edwards, (1998), Openness, Productivity and Growth: What Do We Really Know?, The Economic Journal, 108 (March. and Frankel and Romer, (1999), Does Trade Cause Growth?, The American Economic Review Vol. 89, No. 3, Jun.

([22]) Human capital has long been identified as a source of income convergence. See Lucas, R. (1988), *On the Mechanics of Economic Development* ,Journal of Monetary Economics.

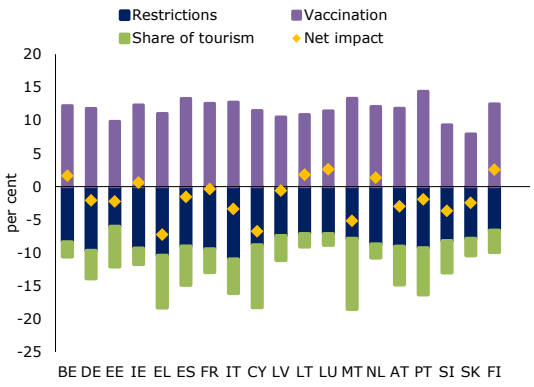
([23]) See Hale, T. et Al. (2020), *Variation in government responses to COVID-19*, BSG Working Paper Series.

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

([25]) Milesi-Ferretti (2021) using a large sample, shows how the deviation of 2020 growth from its pre-COVID forecast is strongly correlated with the share of tourism in GDP and to a lesser extent with other indicators of the supply composition of economic activity. Milesi-Ferretti G.M., (2021) The Travel Shock, CEPR Discussion Papers 16738, C.E.P.R. Discussion Papers.

indicator represented by the annual growth of GDP per capita (in PPS) for the EA-19 is reported in Table I.2 (Column 1-3). Column 1 shows the baseline model for the EA-19 over the 1995-2019 pre-COVID-19 period. This model puts in relation growth rates of per-capita real GDP growth 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 investment is also influenced by expected growth rates. However, there was no evidence of endogeneity for the investment indicator in our sample (See Box I.1). At the same time, an increase in public debt is associated with lower growth in GDP per capita over the long-term ([26]). However, the sign and value of the estimate of the impact of public debt on growth in GDP per capita should be interpreted with care as causality could go in both directions. ([27]) Finally, in Column 2, the base model is extended to cover the COVID-19 crisis period (2020-21) and it remains broadly unchanged suggesting stability of the estimated convergence path ([28]).

Graph I.5: **Cumulative marginal impacts (2020 and 2021) on annual growth in GDP per capita in EA-19, COVID-19 regressors**



(1) Marginal impacts calculated with equation 3 in Table I.2.
Source: Author's calculations.

The baseline model is augmented with COVID-19 variables for the EA-19 and results are shown in Table I.2 (Column 3). As expected, the introduction of lockdown measures to curb the spread of the virus lowered the growth in GDP per capita ([29]). The negative impact of the lockdown measures increases 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 increases with the roll out of the successful vaccination strategy providing evidence that it supported the recovery by facilitating the re-opening of the economy. ([30]) Graph I.5 highlights the estimated cumulative marginal impacts and illustrates how the estimated positive impact of vaccination strategy offset in most countries (at least partially) 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

([26]) Coutinho and Turrini (2020) also find that reducing government debt would reduce the convergence gap. See Coutinho L. and Turrini, A. (2020) *Real Convergence Across the Euro Area. What Role Do Macroeconomic Imbalances Play?,* Intereconomics volume 55. See also Chudik, A, Mohaddes, K, Pesaran, MH and Raissi, M 2010, Debt, Inflation and Growth: Robust Estimation of Long-Run Effects in Dynamic Panel Data Models, CESifo Working Paper Series.

([27]) See for example P. Heimberger (2021) *Do Higher Public Debt Levels Reduce Economic Growth,* The Vienna Institute for International Economic Studies WP 211 and Pescatori, A., Sandri, D and Simon, J *Debt and Growth: Is There a Magic Threshold?,* IMF WP/14/34.

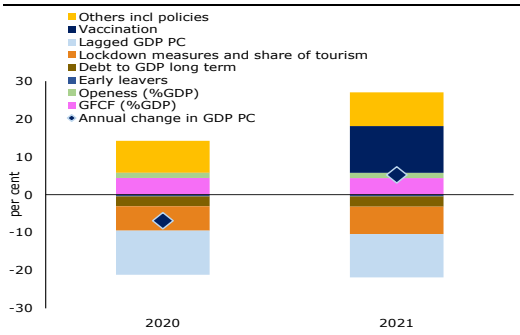
([28]) One issue with our chosen model is that the population growth indicator does not result statistically significant albeit it has the correct negative sign. Population growth accounts for the dilution of capital stock per capita so it was expected to have a negative impact on the rate of growth of GDP per capita. Another issue is that the chosen measure of institutional quality (Economic Freedom Index from the Heritage Foundation) has the correct sign but it is not statistically significant in most regressions. So it was not included in the most parsimonious specification although good quality institutions have long been recognised as an important growth driver for example, via stronger incentives to innovate and take risks that translates into faster total factor productivity growth.

([29]) 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.

([30]) An IMF study on a large sample found that vaccines are statistically associated with variables related to the reopening of the economy, such as NO_2 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, P, Furceri, D, Jimenez, D Kothari, S Ostry JD and Tawk, N 2021, The Effects of COVID-19 Vaccines on Economic Activity. IMF WP No. 2021/248. See also IMF October 2021 WEO, which found that higher COVID-19 vaccination rates are associated with improved output expectations across horizons in a sample of advanced and emerging market economies.

impact of COVID-19 ([31]). Finally, Graph I.6 provides an overview of the contribution of the various estimated drivers of the annual changes in GDP per capita during the COVID-19 crisis.

Graph I.6: **Breakdown of the annual changes in GDP per capita in EA-19 during COVID-19**



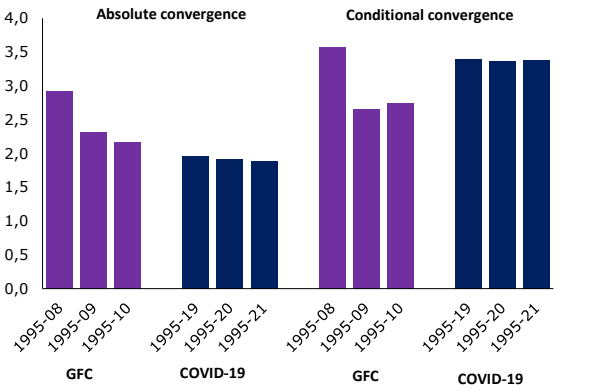
(1) Marginal impacts calculated with equation 3 in Table I.2.
Source: Author's calculations.

I.5. Impact of COVID-19 crisis on income convergence

The COVID-19 crisis had a negative impact on convergence in the EA-19 although such an impact is expected to be more temporary and less sizable 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 emerging from a health emergency the effects of which were mitigated by governments. Given the bold policy response, once government restrictions were lifted, there was limited adjustment pending.

Despite the deeper drop in GDP, regression results in this paper provide support for a less sizable impact on income convergence of the COVID-19 crisis relatively to the global financial crisis. The estimated absolute and conditional beta-convergence coefficients for the EA-19 remained broadly unchanged following the COVID-19 shock (Graph I.7). This suggests that the bold policy response to COVID-19 at 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 have not fully played out yet although the evidence available points to substantially lower long-term damages than following the global financial crisis.

Graph I.7: **Beta coefficients estimates (absolute value)**



(1) Results are for the EA-19 sub-sample but they are qualitatively unchanged for the EU-27. Absolute beta-convergence estimates from Table I.1. Conditional beta-convergence results are based on the equation in Column 3 in Table I.2.

Source: Author's calculations.

Regression results in Table I.2 (Column 5-7) provide evidence of the global financial crisis having 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 Table I.2) 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 onward) is also supported in the data suggesting that the global financial crisis slowed down annual growth of GDP per capita over a lasting period (Column 7 Table I.2). By contrast, results for the COVID-19 period are not statistically significant (Column 6 Table I.2) suggesting that the process of convergence might have been little affected by the pandemic.

I.6. Drivers of the slowdown in convergence after the global financial crisis

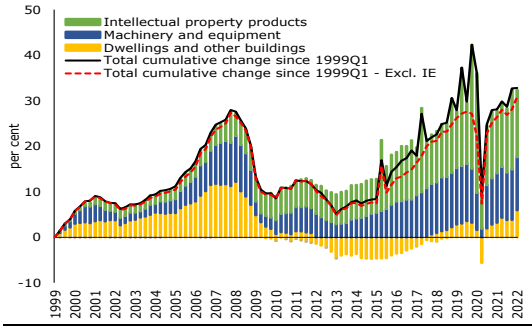
The process of convergence in the euro area slowed down significantly following the global

([31]) See also Canton, E, J. Durán, W Simons, A. Vandeplas, F Colasanti, M Garrone and A Hobza, 2021, The Sectoral Impact of the COVID-19 Crisis. An Unprecedented and Atypical Crisis. European Commission Economic Brief 69.

financial crisis. The estimated conditional beta coefficient is significantly smaller in the post-2007 period (see Column 8-10 in Table I.2 for the EA-19 subsample excluding Ireland and Luxembourg ([32])). 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 (Graph I.8) and gross fixed capital formation (GFCF) took about 10-years to return to its pre-crisis level ([33]). 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 Table I.2). ([34]) This result might suggest that after 2008 the neo-classical convergence channel has not been fully in play because growth in GFCF after the 2008 was relatively weak to support growth in countries. By contrast, in the period before 2008, growth in GFCF was higher in many converging countries. ([35]) 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).

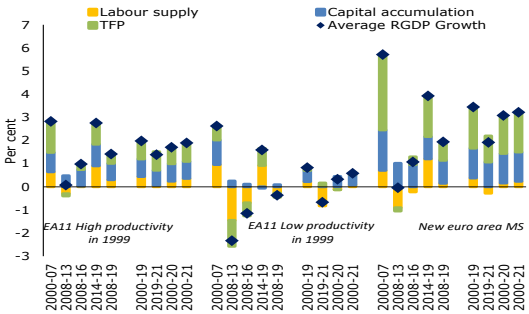
The weakness in the degree of convergence following the global financial crisis might also be related to the more pronounced slowdown in growth of total factor productivity (TFP) (Graph I.9), a key driver of income convergence. Limited productivity catch up and in particular a progressive reduction in 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) ([36]). 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 (Graph I.9). However, the countries with low initial productivity experienced 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 ([37]). Differences across countries, and regions, are also stark in some cases.

Graph I.8: **Cumulative change in GFCF in the euro area since 1999Q1**



Source: Eurostat.

Graph I.9: **Decomposition of average annual GDP growth in EA-19**



(1) Note: Luxembourg is excluded.
Source: AMECO and author's calculations.

([32]) GDP data for Ireland and Luxemburg are distorted by the presence of large multinationals or large financial sectors. In Table I.2 (column 5-10) the beta convergence equation has been re-estimated excluding Ireland and Luxemburg. Regressions results are qualitatively unchanged in this smaller sample.

([33]) When Irish data are excluded, GFCF recovered its pre COVID-19 level within 2 years. See also Licchetta and Meyermans (2022).

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

([35]) Over the 1996-2007 period, many Member States who 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 have been consistently lower than in the period 1996-2007.

([36]) 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 J., E. Dorrucci, F. Heinz and S. Muzikarova (2017). *Real convergence in the euro area: a long-term perspective* European Central Bank. Occasional Paper Series, No. 203 / December and IMF (2017), *Euro Area Policies Selected Issues*, Country Report No. 2017/236.

([37]) Čihák M., Fonteyne W. (2009), Five Years After: European Union Membership and Macro-Financial Stability in the New Member States, IMF WP No. WP/09/68.

I.7. Conclusion and implications for policy

The COVID-19 crisis was like no other and had more severe consequences on countries particularly exposed to 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, and physical and human capital. The latter driver of growth is particularly 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 a key role for skill policies in addressing the root causes of labour shortages. Finally, this paper further stresses the need to tackle structural economic weaknesses and improve productivity growth, a main driver for income convergence.

Completing the EU integration process by deepening the single market, completing the banking union and the capital market union, remain therefore of primary importance to support the process of convergence through productivity advances. This paper also provides intellectual support to two critical rationales for NextGenerationEU (NGEU), boosting growth potential in the EU through productivity enhancement and supporting countries that are weaker (in terms of lower GDP per capita and higher public debt). At the same time NextGenerationEU signals a firm political commitment to protect the region's cohesion 'at all times', further strengthening the euro area's financial architecture during the pandemic.

Table I.2: **Conditional beta convergence estimates**

Y = Change in Real GDP PC PPP	(1) EA19 Base pre COVID-19	(2) EA19 Base All	(3) EA19 Augm All	(4) EU27 Augm All	(5) EA19 ex GFC dummy interacted	(6) EA19 ex COVID 19 dummy interacted	(7) EA19 ex Post 2008 dummy	(8) EA19 ex Augm All	(9) EA19 ex Pre GFC	(10) EA19 ex Post GFC
Time	**1995-2019**	**1995-2021**	**1995-2021**	**1995-2021**	**1995-2021**	**1995-2021**	**1995-2021**	**1995-2021**	**1995-2007**	**2008-2021**
Real GDP 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 (% GDP)	0.014***	0.015***	0.015***	0.013***	0.010***	0.009***	0.010***	0.008***	0.005	0.015***
Early 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 (% pop)			0.158***	0.158***	0.162***	0.152***	0.157***	0.161***		0.156***
Global Financial Crises (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***			
Real GDP 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
R2	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	3.1

Note: * p<0.10; **p<0.05; *** p<0.01.
Source: Author's calculations.

Box I.1: **Modelling income convergence**

This paper estimates conditional beta convergence for the euro area and the EU with panel regression using annual data from 1995 to2021 (1). Following previous studies (2) we estimate the following conditional beta convergence equation:

$$\Delta lnY_{it} = \alpha + \beta lnY_{it-1} + \gamma X_{it} + \varepsilon_{it} \qquad (1)$$

where: Yit = real GDP per capita; Xit= a set of quantitative (e.g. macroeconomic and institutional factors) and qualitative (e.g. dummy variables) control variables that condition convergence; i = countries; t = time period over which growth rate is computed and β = 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 & Tourism Council and vaccination data from the European Centre for Disease Prevention and Control.

Several variables widely used in the growth literature were simultaneously estimated in the baseline model with pooled 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. Several tests have been performed to assess the robustness of the central results of this paper (Table A). The most notable findings are:

- The baseline model (Column 1) is estimated using annual data. Focusing in such a short period, there is a risk of capturing some cyclical aspects. However, results are broadly unchanged when: 1) following standard practice in the estimation of growth regressions with panel data, annual observations are converted into averages over non overlapping, 5 year sub-periods, to reduce the effects of cyclical disturbances on the results (Column 2) (3); 2) initial conditions are lagged by 2 years (Column 3), rather than 1 year as in the base model (Column 1); and 3) the dependent variable is real GDP per capita not in PPS (Column 4) (4).

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

- 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

(1) A difference from cross sectional approaches, a panel data approach allows the variation both across countries and across time.

(2) See for example Coutinho L. and Turrini A. (2020) and Berti, K and. Meyermans, E. 2018, *Sustainable convergence in the euro area: A multidimensional process*, Quarterly Report on the Euro Area (QREA), European Commission, vol. 16(3), pages 3-24.

(3) Focusing on 5 year averages allows us to investigate the drivers of trend growth whereas focusing on annual data aims at considering the cyclical variation in the growth of GDP per capita. However, 5 year averages are not suitable to study the impact of COVID-19 on convergence because the time period affected is too short to identify 'structural' trends in average growth. In addition, 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 2 years immediately after the beginning of the two events.

(4) In addition, results are qualitatively unchanged (not shown in the table) when 1) the regression model is estimated with annual data transformed in 2,3 and 4 year moving averages and 2) when the augmented model is re-estimated with years and regional dummies.

(5) 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. It cannot therefore be rejected the null hypothesis that investment can be treated as exogenous in this sample. See Baum, C. F. Schaffer, M. E. and Stillman, S. (2003) Instrumental variables and GMM; Estimation and testing", Stata Journal 3: 1-31. The investment indicator remains positive and statistical 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 instrument for the investment indicator delivering the expected negative sign, significant coefficients while the other regressors are qualitatively unchanged. On the latter approach see also Bower U. and Turrini, A. (2009), *EU Accession: A road to fast-track convergence?* Economic Papers 393, December 2009.

(Continued on the next page)

Box (continued)

standard errors are computed (Column 7) or GLS coefficient estimates with panel corrected standard errors are adopted (Column 8-9) or under the random effect estimator (Column 10) ([6]).

Table A: Conditional beta convergence in EA19 (1995-2021): robustness

Y = Change in Real GDP PC (PPS)	(1) Base	(2) Base 5y not overlap average	(3) Y= Change in Real RGDP PC T=2	(4) Y= Change in Real RGDP PC (No PPS)	(5) Augmented Model	(6) GFCF Ex-Dwellings	(7) Pooled OLS Disc Kray	(8) PCSE GLS	(9) XT GLS	(10) Random Effects XT REG
Real GDP PC PPS (lag)	-3.390***	-2.807***			-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 (% GDP)	0.015***	0.013***	0.014***	0.012***	0.015***	0.012***	0.015***	0.016***	0.015***	0.015***
Early 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 (% pop)					0.158***	0.159***	0.158***	0.161***	0.169***	0.158***
GFCF (Ex D) (% 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
R2	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

([6]) The inclusion of country fixed effects was also tested while favouring random effects. This is consistent with Bell and Jones (2015), which shows that in the context of macroeconometric panels (as opposed to microeconometric panels), the more parsimonious random effect model is often superior to the fixed effects model. See Bell and Jones (2015), Explaining Fixed Effects: Random Effects Modeling of Time-Series Cross-Sectional and Panel Data, Political Science and Research Methods. See also Pamies, S, Carnot, N. and Pătărău, A , (2021), *Do Fundamentals Explain Differences between Euro Area Sovereign Interest Rates?*, ECFIN DP 141, June 2021.

II. Links between housing and real economy in the euro area

By Bořek Vašíček and Václav Žďárek

Abstract: *Housing represents a large share of household wealth and housing market developments are of high importance for the overall economy. Since 2014, house prices have increased across the euro area and accelerated further since the COVID-19 pandemic. This article analyses the links between GDP, residential construction, lending rates, mortgage credit and house prices in the euro area, and tests the impact of macroprudential and monetary policy on housing markets. The empirical results confirm that there are strong links between the housing market and the real economy at euro area level. The differences in these links across Member States can, at least in part, be related to different degrees of elasticity of the housing supply. The results also found that both macroprudential and monetary tools have a significant impact on house prices and on mortgage credit in the euro area.*

II.1. Introduction

Housing is a special type of good, characterised as a durable asset or a stream of services for the owner. Housing also represents a large share of household wealth and a main reason for households to take on long-term debt. Changes in house prices thus affect household spending and investment decisions. In the longer term, they also affect the redistribution of resources across and within generations. ([38]) Residential mortgages constitute a substantial component of the asset portfolios of financial institutions, so changes in house prices also affect the financial sector's performance. ([39]) All in all, housing market developments can have large effects on economic activity, on financial stability and on overall welfare, which was highlighted during the Global Financial Crisis (GFC) of 2008. ([40])

House price developments are the outcome of demand and supply conditions that are determined by the level of economic activity, financial conditions, institutional structure of housing markets and housing-related policies. ([41]) These factors are intertwined and have both euro area and country-level dimensions, which can give rise to differences across countries. Though the euro area shares a common monetary policy, there are differences between national residential markets and mortgage markets. Coupled with macroprudential measures taken at country level, this results in differences in credit availability and funding conditions. There are also differences in zoning and building regulation across and within the Member States, which create differences in housing supply elasticity, ([42]) i.e. changes in new residential constructions to changes in housing demand. Finally, different modalities of housing-related taxation ([43]), including subsidies for home ownership, rental regulations and the provision of social housing are all policy factors that affect demand for housing, alongside fundamental drivers such as income and population growth.

Recently, given the links between housing and the real economy, there has been a greater emphasis on monitoring and assessing house market trends in macroeconomic surveillance and policy. For example, the Commission uses different approaches to estimate benchmarks for house prices. ([44]) In addition to comparing the current price levels with the estimated benchmarks (i.e. assessment of the valuation gaps), it is also important to understand the short-term dynamics of house prices and the role of different shocks, including monetary and macroprudential shocks.

([38]) Campbell, J. and J. Cocco (2007). How do home prices affect consumption? Evidence from micro data. *Journal of Monetary Economics*, 54(3), 591-621.

([39]) Martins, M., A. Serra, F. Martins and S. Stevenson (2019). Residential property loans and bank performance during property price booms: Evidence from Europe. *Annals of Economics and Finance*, 20(1), 247-295.

([40]) Martins, V., A. Turrini, B. Vašíček and M. Zamfir (2021). Euro Area Housing Markets: Trends, Challenges and Policy Responses, European Economy – Discussion Papers No 147.

([41]) For very comprehensive review of drivers of house prices see: Duca, J. V., J. Muellbauer and A. Murphy (2021). What drives house price cycles? International experience and policy issues, *Journal of Economic Literature*, 59(3), 773-864.

([42]) Andrews, D., A. C. Sánchez and A. Johansson (2011). *Housing markets and structural policies in OECD countries*. Paris: OECD Publishing.

([43]) Fatica, S. and D. Prammer (2018). Housing and the tax system: how large are the distortions in the euro area? *Fiscal Studies*, 39(2), 299-342.

([44]) Philiponnet, N. and A. Turrini (2017). Assessing House Price Developments in the EU. European Economy – Discussion Papers No 048. Philiponnet, N. (2018). The start of a new cycle: Recent housing price dynamics in Europe and their macroeconomic implications, *Quarterly Report on the Euro Area*, 3, 57-68.

For example, the ECB's ongoing monetary tightening cycle can subdue housing demand in the euro area due to the rising cost of borrowing. However, it can also have collateral and wealth effects and in turn curb household spending and the overall output. As the house price dynamic is an important driver of residential construction ([45]), the resulting adjustment of house prices may dampen residential investment, which may also have a significant bearing on GDP.

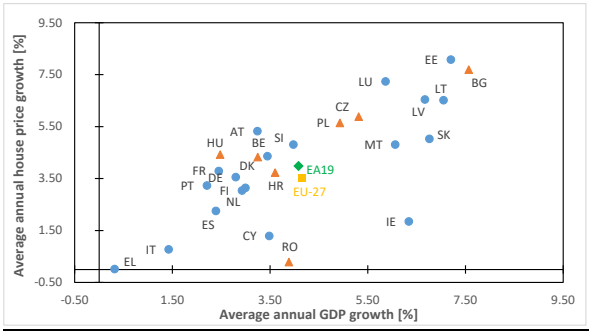
This Section is organised as follows. In the next subsection we describe the main developments in the housing markets in the euro area and across euro area countries. Then we describe the empirical model tracking links between housing and the real economy and show the results. We then extend the model to bring in policy variables (macroprudential tools and the shadow rate). The fourth subsection concludes and suggests paths for further analysis.

II.2. Main developments in the euro area

In the long term, the increase in house prices in the EU is related to GDP growth (Graph II.1). High GDP growth is generally accompanied with high house price growth. ([46]) The Member States that are catching up feature the highest increase in house prices. In the euro area, nominal house prices grew at around 4% annually over the period 2004-2022, which is almost the same as nominal GDP growth over that period. ([47])

Looking at the euro area as a whole, house prices have followed several phases over the last two decades (Graph II.2): (a) increasing (significantly in some countries) during much of the first decade interrupted by the onset of the GFC, (b) stagnating (or for some countries experiencing a significant correction) after the crisis, before (c) increasing again steadily (from 2014 onwards) and accelerating since the pandemic. ([48])

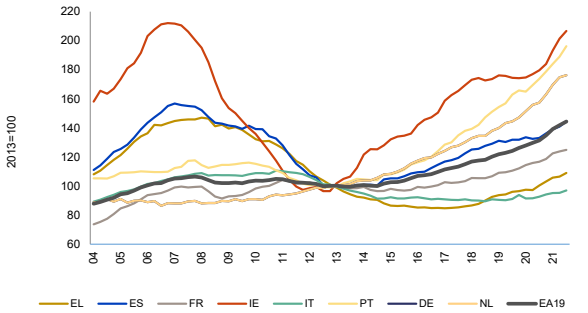
Graph II.1: **Nominal GDP growth vs house prices growth, EU-27**



(1) The circles stand for euro area countries, the triangles for non-euro area countries, EA-19 (diamond) and EU-27 (square) are simple averages of those Member States; nominal GDP in euro (seasonally and calendar adjusted data); all averages cover the sample period (2004q1–2022q1) except for CZ (2005q1–2022q1), EE (2004q3–2022q1), HU (2008q1–2022q1), MT (2006q1–2022q1), PL (2006q1–2022q1), RO (2010q1–2022q1) and SK (2006q1–2022q1) due to the availability of house prices.

Source: Eurostat, own calculations.

Graph II.2: **House prices, selected euro area countries**



(1) EA-19 is a simple average of those Member States.

Source: Eurostat, own calculation.

House price developments can be assessed against construction activity in the euro area. Building permits, which can be seen as a noisy proxy for new residential developments (indicating the intention to build, Graph II.3) have fallen since the GFC. ([49]) This was very pronounced in countries

([45]) Dohring, B. (2018). Cyclical patterns of residential construction, *Quarterly Report on the Euro Area*, 3, 59-67.

([46]) For completeness, when considering only the real annual GDP growth, its rate reached 1.9% over the sample period (2004q1-2022q1). For comparability reasons, all averages mentioned in this paragraph are calculated as unweighted averages of quarterly growth rates of twelve euro-area Member States ('old euro area members') listed below in the text.

([47]) Irish GDP growth has been increasingly influenced by the inclusion of foreign-owned multinational enterprises; see Box in ECFIN, 'European Economic Forecast', Summer 2022, Institutional Paper 183, July 2022. The average house price growth in Romania may be influenced by the data availability in the analysed period (a burst of a bubble in late 2000s).

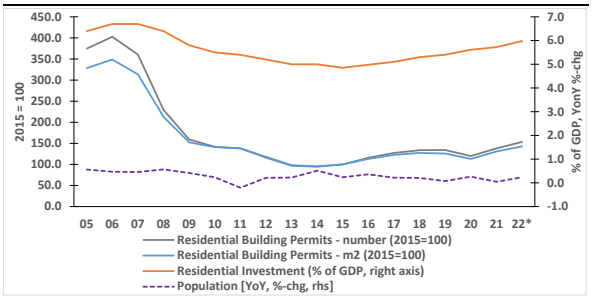
([48]) For an early analysis of house-price developments in the euro area, see 'Focus: Assessing the dynamics of house prices in the euro area', *Quarterly Report on the Euro Area*, 4, December 2012, 7-18.

([49]) The data on building permits shown in the graph should be interpreted carefully as the euro-area aggregate before the Global Financial Crisis was driven by few countries with a large number of building permits (reflecting the speculative nature of some projects during the real estate bubble).

such as Spain but the trend has been broad-based across euro area countries, and the recovery that started in 2014 was only very mild. The ratio of residential investment to GDP fell after the GFC too before it started to recover around 2015.

However, part of this recovery was driven by renovation to increase the energy efficiency of buildings. ([50]) That is important in terms of environmental goals, but it does not add significantly to the existing housing stock. Housing supply constraints in the euro area are to a large extent driven by stringent zoning and building regulations, ([51]) meaning they are likely to persist despite the ongoing post-pandemic recovery. ([52])

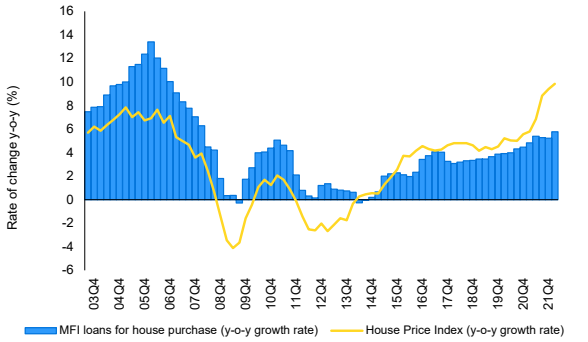
Graph II.3: **Building permits, housing investment and population**



(1) *22 = based on the first quarter of 2022.
Source: Eurostat, own calculations.

House price developments have been closely linked to mortgage credit (Graph II.4) ([53]) and mortgage credit developments roughly match the phases identified for house prices at euro area level. However, while mortgage credit growth outpaced house price growth before the GFC, the opposite happened when the COVID-19 pandemic hit. ([54]) Even though credit cycles were quite synchronised across euro area countries, the amplitude of the cycles differed significantly (Graph II.5). Several Member States that experienced a mortgage boom before the GFC crisis suffered from deleveraging right afterwards. Since then, mortgage credit has risen only slightly across euro area countries.

Graph II.4: **House prices and mortgage credit, the euro area**

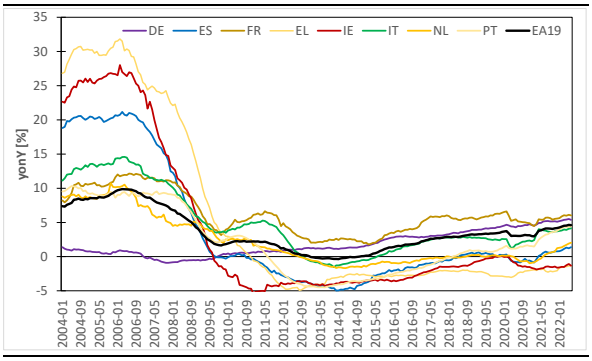


Source: ECB, Eurostat.

During the past decade, the moderate development of mortgage credit can be related to the increasing use of macroprudential measures aimed to limit excessive credit growth, which is a main component of systemic risk for the financial sector. ([55])

Borrower-based measures were brought in across the euro area, such as limits on loan-to-value (LTV) and debt-service-to-income ratios (Graph II.6). These measures remained in place in most Member States, even during the COVID-19 pandemic. ([56])

Graph II.5: **Mortgage credit growth, selected euro area countries**



(1) EA-19 is a simple average of respective Member States.
Source: Eurostat, own calculation.

([50]) The higher share of renovations can be demonstrated by different measures of initiated and completed dwellings, in addition to the discrepancy between building permits and residential investment on GDP that also increased at a slower pace than residential investment.

([51]) Cavalleri, M.C.., B. Cournède and E. Özsögüt (2019). How responsive are housing markets in the OECD? National level estimates, OECD Economics Department Working Papers No 1589.

([52]) In some places, the reconversion of some office areas into residential areas following ongoing changes in working patterns may increase the supply of housing.

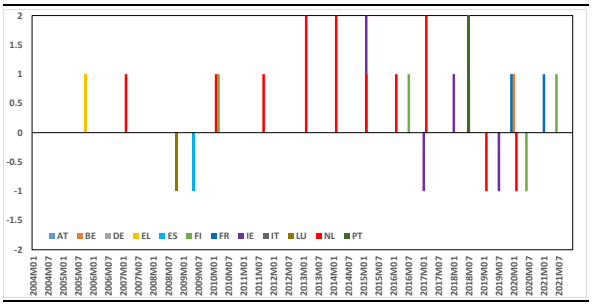
([53]) Cyclical co-movement between house prices, credit and other financial variables has been coined the financial cycle, see Monteiro, D and B. Vašíček (2018). Financial cycle in euro area, *Quarterly Report on the Euro Area*, 2, 17-30.

([54]) This is consistent with the substantial lack of recovery in volumes – as opposed to prices – in the aftermath of the GFC.

([55]) Cerutti, E., S. Claessens and L. Laeven (2017). The use and effectiveness of macroprudential policies: New evidence, *Journal of Financial Stability*, 28, 203-224.

([56]) ESRB macroprudential database.

Graph II.6: **Housing-related borrower-based measures implemented in the euro area**



(1) The positive (or negative) unit value indicates tightening (or easing) of LTV or DSTI limits (i.e. 1 is tightening of one measure, 2 is tightening of both measures, and vice versa). Euro area = EA-12.

Source: IMF, ESRB macroprudential database.

II.3. Empirical evidence on the links between housing and the real economy

This subsection provides empirical evidence on the links between the housing market and the real economy in the euro area using a panel Bayesian vector autoregression (BVAR) model. ([57]) The dataset covers 12 euro area countries (AT, BE, DE, ES, EL, FI, FR, IT, IE, LU, NL, PT) over the period Q1 2004–Q1 2022. These countries were selected due to data availability for the main variables and euro area membership during the whole sample period.

The panel setting is useful to extend the time data sample, which is limited by the availability of some variables. The baseline model includes seven variables: ([58]) (*i*) real GDP (annual change in %), (*ii*) harmonised consumer prices (HICP, annual change in %), (*iii*) mortgage lending rate (annualised agreed rate for new business, in %), (*iv*) building permits (annual change in % based on the number of permits for m^2 of useful floor area), ([59]) (*v*) mortgage credit (lending for house purchases, annual change in % of the stock, excluding valuation effects), (*vi*) credit conditions (annual change in % of the relative ratio between tightening and easing by banks; an increase represents a relative tightening) ([60]) and (*vii*) house prices (annual change in %). The data come from the ECB and Eurostat. All series are stationary, and the underlying series were adjusted seasonally (and by working day) at the source or by applying the TRAMO/SEATS methodology. The extended model also uses alternatively (*viii*) a macroprudential policy index ([61]) and (*ix*) a monetary policy shadow rate (see details below).

The empirical results confirm that there are significant links between the real economy and the housing sector at euro area level, which is intermediated by the banking sector. Graph II.7 shows the impulse response function (IRF) of the seven variables included in the baseline panel BVAR model (the columns show the shocked variables, and the rows show the responses). ([62])

([57]) The BEAR toolbox for Matlab [ver. 5.2] is used to make all estimations. See https://www.ecb.europa.eu/pub/research/working-papers/html/bear-toolbox.en.html.

([58]) This model is an extension of the simple panel bivariate BVAR analysis with house prices and mortgage credit used in Martins et al. (2021). The variables are ordered in the baseline VAR as listed, i.e. from *(i)* to *(vii)*. Namely, the first three variables follow the ordering of standard monetary VARs, namely output, prices and interest rates. The ordering of the remaining four variables is less straightforward but we use yearly changes of the variables where the ordering of variables is less relevant (see Footnote 61).

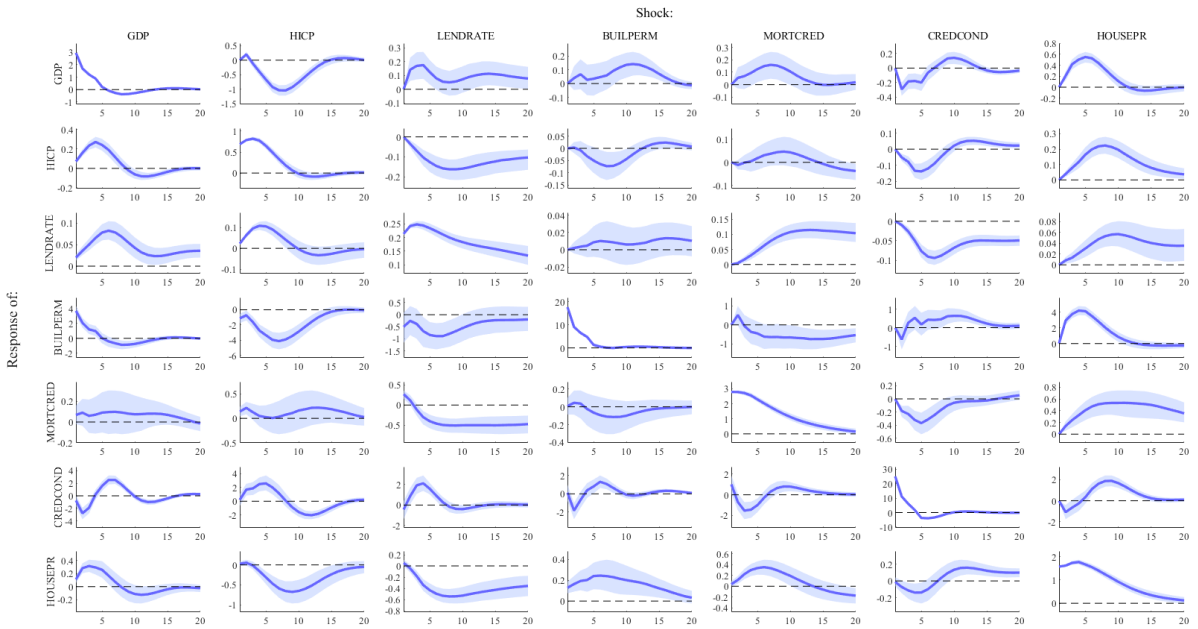
([59]) Eurostat defines it as 'the objective of the number of dwelling building permit index is to show the future development of construction activity in terms of residential units, while the objective of the useful floor area building permit index to show the future development of construction activity in terms of square metres. A building permit is an authorisation to start work on a building project. As such, a permit is the final stage of planning and building authorisations from public authorities, prior to the start of work'.

([60]) The ECB surveys credit conditions quarterly for all euro area banks (loans for house purchases by household); for details see Box in ECB, Euro area bank lending survey – Second quarter of 2022, July 2022.

([61]) The IMF's iMaPP database provides dummy-type indicators of tightening and loosening decisions on various macroprudential policy instruments at monthly frequency. Namely, we sum all the decisions regarding the LTV and DSTI limits into a single index each quarter. The database is described in Alam, Z., M. A. Alter, J. Eiseman, M. R. Gelos, M. H. Kang, M.M. Narita, and N. Wang (2019). Digging deeper, Evidence on the effects of macroprudential policies from a new database. International Monetary Fund Working Paper, No 19/66. For 2021, we use data from the ESRB database of macroprudential measures and sum them up in the same way with the IMF database.

([62]) A pooled estimator is used with normal Wishart prior (hyperparameters are set as follows: autoregressive coefficient: 0.8, overall tightness: 0.1, cross-variable weighing: 0.5, lag decay: 1). The reported impulse-response functions rely on the Cholesky factorisation, where results depend on the ordering of variables used in the VAR model. However, alternative orderings produce almost identical results. We use for some variables (annual) changes rather than levels (e.g. annual house price changes of house prices index rather than the price index itself) so that they are stationary. We use annual rather than quarterly changes as the aim of our analysis is to track longer-term developments (rather than to forecast trends). While the annual changes of the variables tend to produce more persistent responses, the sign and statistical significance is the same as with quarterly changes. Moreover, with variables defined in yearly changes, the ordering of variables in the VAR model has a much lower impact on impulse-response analysis than with quarterly changes.

Graph II.7: **Impulse response function from baseline panel BVAR, 12 euro area countries**



Source: Authors' calculation based on ECB and ESTAT data.

A positive **GDP** shock, ([63]) which can be also interpreted as an income shock (*first column*), has an immediate positive effect on building permits. It eases credit conditions and pushes up house prices (and mortgage credit, though insignificant). With a delay of around two quarters, the positive GDP shock leads to a peak in mortgage lending rates and a tightening of credit conditions.

An **inflation** shock (*second column)* triggers a gradual drop in economic activity (GDP, building permits). It leads to an increase in mortgage lending rates, tightening credit conditions and, with some delay, a fall in house prices.

A shock to **lending rates** (*third column*) leads to a tightening of credit conditions and a drop in building permits, mortgage credit and house prices.

A positive shock to **building permits** (*fourth column*) has less of a statistically significant impact on other variables, except for GDP and house prices, both of which are boosted. The lack of significant impact may come from the fact that building permits are only a proxy variable (intention to build vs actual construction), while the counterintuitive response seen in house prices may be associated with the housing boom before the GFC when in several Member States both building permits and house prices grew at the same time.

A positive shock to **mortgage credit** (*fifth column*) leads, in the short-term, to an easing of credit conditions and an increase of house prices. With some delay, it also pushes up GDP and lending rates.

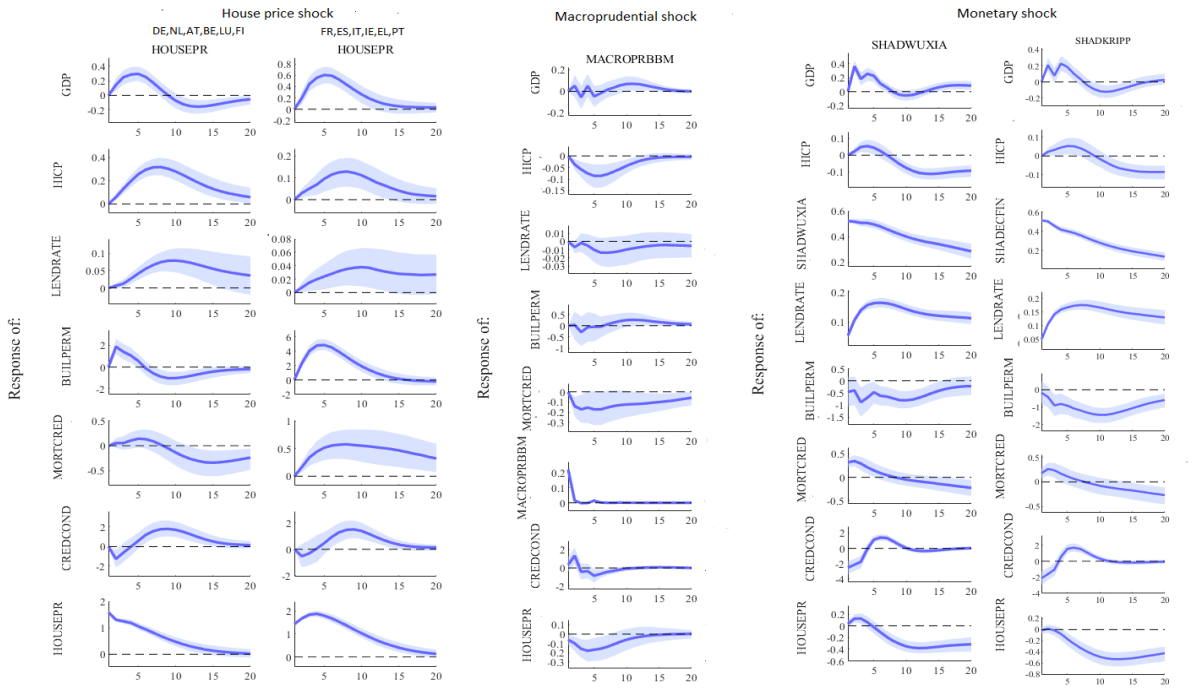
A positive shock (i.e. tightening) to **credit conditions** (*sixth column*) has a short-term negative effect on mortgage credit, consumer and house prices and GDP and in the medium-term is followed by a drop in lending rates.

Finally, a positive shock to **house prices** (*seventh column*) results in a quick increase in building permits, mortgage credit and GDP. With some delay it leads to higher consumer prices, mortgage rates and a tightening of credit conditions.

Housing market developments differed significantly across euro area countries over the last two decades. Notably, housing markets experienced boom and bust dynamics in some Member States during the GFC but in others they exhibited greater stability.

([63]) The impulse-response functions measure the effect of a shock to an endogenous variable on itself and on the other endogenous variables. The shock shall be understood as an unexpected innovation (i.e., autonomous change) of each variable (of size of one standard deviation).

Graph II.8: **Impulse response function from different panel BVARs, 12 euro area countries**



Source: Authors' calculation based on ECB and ESTAT data.

To shed some light on possible differences in the links between house prices and the real economy in the two groups of countries, we carried out an analysis on *two subsamples of Member States*, the first consisting of AT, BE, DE, FI, LU, NL and the second consisting of EL, ES, FR, IE, IT, PT. (64) Graph II.8 (*left panel*) shows responses to a house price shock. While the IRFs are broadly consistent for both groups, the second group of countries shows a much stronger increase in building permits, mortgage credit and GDP following a positive house price shock. In other words, a negative house price shock observed after the GFC implied a faster fall of these variables in the second group of countries.

Results also indicate that building permits respond significantly strongly to other shocks (e.g. GDP shock) for the second group of countries. Likewise, a shock to building permits causes significantly stronger responses in other variables (e.g. GDP). This could indicate that differences in supply-side elasticity across euro area countries (captured here by the differences in building permitting) affect the transmission of shocks between house prices, mortgage credit and the real economy. Namely, higher housing supply elasticity reinforces the link between the housing market and the real economy. This link can be potentially destabilising when a boom-bust dynamic sets in. (65)

The link between housing, mortgage credit and the real economy may also have changed since the GFC, as *new macroprudential tools* were brought in to prevent excessive credit provision. Graph II.8 (*middle panel*) shows the responses of the variables to a macroprudential shock from the panel BVAR model extended with a macroprudential index tracking *borrower-based measures* (BBM) targeting the housing market, (66) i.e. changes to loan-to-value

(64) While there are some evident cases of Member States experiencing boom and bust dynamics during the GFC such as ES, EL, IE, PT and others seem not to be affected at all (e.g. AT, DE). To create these two subsamples, three main housing-related variables (house prices, building permits and mortgage credit) were analysed in terms of their standard deviation. The countries were ranked accordingly for each of the three variables and the sample of twelve countries was split into two groups of equal size. The split was consistent across the three variables except for FR and NL, which represent borderline cases. However, their pairwise exchange across the two groups does not change results.

(65) The time series are too short to run individual country VARs. Specifically, as the time sample is very short, the confidence bands are very wide. Still, some of the key results are confirmed at country level. For example, the house price shock and the GDP shock trigger a much stronger response of building permits in ES than in DE.

(66) The analysis includes only BBM as opposed to broader capital or liquidity macroprudential measures as the former have the direct

(LTV) and debt-service-to-income (DSTI) limits. ([67])

These results confirm that a positive macroprudential shock (tightening) dampens both mortgage credit and house prices, but it has no significant impact on GDP. ([68]) The same analysis repeated for the two groups of countries (not shown here), confirms the important role of housing supply elasticity. In the second group of countries (EL, ES, FR, IE, IT, PT), macroprudential tightening triggers a fall in building permits, but not in the first group (AT, BE, DE, FI, LU, NL). Likewise, house prices fall in the second group of countries following macroprudential tightening but not in the first group, where instead the negative response of mortgage credit is more pronounced. ([69])

Lastly, there has been some discussion about the links between housing markets and *monetary policy*. The ongoing discussion is on how house price developments are affected by the monetary policy stance and how housing market conditions affect the transmission of monetary policy to the real economy. Graph II.8 (*right panel*) shows the responses to a monetary policy shock using the panel BVAR model extended by two alternatives measures of the euro area shadow rate, ([70]) namely the one put forward by Wu-Xia ([71]) and another estimated by Krippner. ([72]) To illustrate the level of actual market rates, the graph also shows the three-month interbank interest rate.

The results are subject to a high degree of uncertainty as shadow rates are only proxies for the ECB's monetary policy stance (which reflects different policy tools). ([73]) They suggest that monetary policy has the predicted effect on the housing market. A positive monetary shock (tightening) is followed by an increase in lending rates and a decrease in building permits, mortgage credit and house prices. ([74]) In turn, monetary policy seems to respond to mortgage credit shocks and house price shocks (not shown here). The analysis of the two groups of countries confirms that supply elasticity also plays a role in monetary transmission. In other words, after monetary tightening, there is a sharper decrease in building permits and house prices in the second group (EL, ES, FR, IE, IT, PT).

These results suggest that the long period of very accommodative monetary policy (when the shadow rates were deeply negative) (see GraphII.9) has had an impact on house price dynamics. ([75]) Likewise, the ongoing monetary tightening is likely to cool down housing demand. However, the ultimate impact on prices will also depend significantly on the housing supply in times of uncertainty (including increasing energy and building material prices).

aim to prevent real-estate related risks. Empirical evidence (see Footnote 70 below) commonly uses LTV and/or DSTI limits.

([67]) This variable is ordered after mortgage credit assuming that macroprudential policy responds on impact to mortgage credit but not vice versa, i.e. that the application of new macroprudential measures is delayed.

([68]) Similar findings were reported using a broader sample of countries by Andrieş, A. M., F. Melnic and N. Sprincean (2021). The effects of macroprudential policies on credit growth, *The European Journal of Finance*, 28(10), 1-33 and Poghosyan, T. (2020). How effective is macroprudential policy? Evidence from lending restriction measures in EU countries. *Journal of Housing Economics*, 49, 101694. The ambiguous effect of a macroprudential shock on GDP is consistent with Richter, B., M. Schularick and I. Shim (2019). The Costs of Macroprudential Policy, *Journal of International Economics*, 118, 263-282 who find that tightening LTV limits affect house prices and growth of household debt, but in advanced economies they have only small effect on output and inflation.

([69]) There is no evident ranking of countries by housing supply elasticity. Again, there are only evident cases of elastic supply such as EL, IE and cases of inelastic supply such as NL, LU.

([70]) The use of a shadow rate as a proxy for monetary policy is necessary given the period of unchanged very low (zero) or even negative interest rates. Shadow rates is ordered after the GDP and before HICP as monetary policy rate in a standard monetary VAR model.

([71]) For details on the shadow rate see Wu, J. C. and F. D. Xia (2017). Time Varying Lower Bound of Interest Rates in Europe, Chicago Booth Research Paper No 17-06, April 2017 and Wu, J. C. and F. D. Xia (2020). Negative Interest Rate Policy and Yield Curve, *Journal of Applied Econometrics*, 35 (6), 653-672.

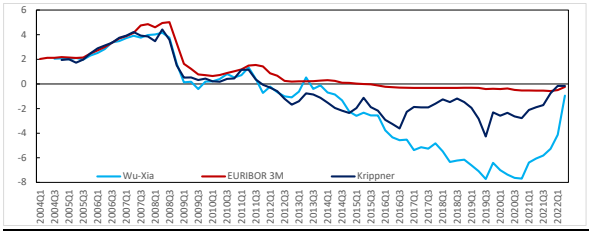
([72]) For details on this shadow rate, see Krippner, L. (2012). Measuring the stance of monetary policy in zero lower bound environments, *Economic Letters*, 118, 135-138; Krippner, L. (2014). Measuring the stance of monetary policy in conventional and unconventional environments, CAMA Working Papers, Centre for Applied Macroeconomic Analysis, Crawford School of Public Policy, the Australian National University.

([73]) Since the shadow rate is an estimate, there is uncertainty around its value, and different measures of shadow rates can provide a somewhat different picture. Consequently, two different measures of shadow rates are used. However, the VAR estimates of monetary policy shock using shadow rates are subject to significant uncertainty that cannot be traced by standard confidence intervals.

([74]) The counterintuitive temporary increase of GDP, inflation and mortgage credit following monetary tightening (which holds for both measures of shadow rates and both for VAR in yearly and quarterly changes) is largely driven by the erratic behaviour after the pandemic. When these data are excluded, the increase of GDP and credit is only minor, while the consecutive decline is more pronounced. Moreover, monetary policy is effective only over the medium term, i.e. after two years, all the variables give the expected negative response.

([75]) This is consistent with recent evidence by Hülsewig, O. and H. Rottmann (2021). Euro area house prices and unconventional monetary policy surprises, *Economics Letters*, 205, 109962 showing that the unconventional monetary policy of the ECB contributed to the rise in house prices in the euro area.

Graph II.9: **Shadow policy rate estimates and EURIBOR for the euro area**



(1) EURIBOR 3M = 3-month interbank borrowing interest rate in the euro area (quarterly average); Wu and Xia and Krippner shadow rates are based on alternative models; shadow rate values shown correspond to the last month of a quarter (as of September 2022).
Source: Bloomberg, ECB, Wu-Xia and own calculations.

II.4. Conclusions

House prices in the euro area have increased persistently since the beginning of the recovery in 2013 and accelerated since the COVID-19 pandemic. However, over a longer period, house prices in the Member States have shown different patterns due to country-specific economic developments, housing market structures and policy factors (e.g. building regulations and housing-related taxation).

The analysis of this section confirms that there are significant links between housing market developments and the real economy at the euro area level. It also confirms that the strength of these links depends on housing supply elasticity (as proxied by the variability of building permits). In line with anecdotal evidence, stronger links between housing markets and the economy are found in the Member States that experienced turbulent house prices during the GFC. These are the economies where housing permits respond more to increases in house prices.

The analysis also confirms the efficiency of borrower-based macroprudential measures on target variables (both house prices and mortgage credit) with limited collateral effect on economic activity. Looking at the dynamics within the euro area, different responses to macroprudential tightening are found between the same two groups of countries. The changes in monetary policy stance of the ECB are found to have an impact both on house prices and on mortgage credit in the euro area. However, links between monetary policy and housing markets are subject to large uncertainty given the prolonged period when unconventional monetary policy measures were employed.

Housing supply elasticity seems to play a crucial role in the nexus between housing and the real economy. It is determined by multiple country-specific factors, most notably land-use regulations and building regulations. ([76]) In terms of macroeconomic outcomes, supply elasticity is a double-edged sword though. The responsiveness of housing supply to demand pressures is needed to make housing affordable. In countries where the supply is very staggered, the risk of a major downward correction and thus a boom-bust cycle is more contained. But high prices and low housing affordability have an adverse impact on the labour market, productivity, and the equality of wealth distribution. Conversely, flexible housing supply makes large expansions or contractions of construction activity driven by changes in mortgage credit and house prices possible, with (corresponding) implications for the whole economy. ([77])

The model presented in this section is mainly helpful in understanding pre-pandemic house price developments. The effects of the pandemic brought about some unusual developments. First, house prices have accelerated further since the beginning of the pandemic, in stark contrast with previous recessions. This seems to be driven by persistent demand, by favourable funding conditions and by changes in housing preferences. Second, housing supply was further constrained by the pandemic measures. Multiple sources of uncertainty are weighing on economic activity, inflation is running high and credit conditions are tightening. Given the persisting housing supply constraints, even a drop in demand for housing is unlikely to result in a significant downward correction of house prices. Nevertheless, high house prices and tighter access to credit are likely to have a negative effect on the affordability of housing, which has significantly deteriorated in recent years across the EU. ([78])

([76]) Cavalleri, M. C., B. Cournède, B. and E. Özsöğüt (2019). How responsive are housing markets in the OECD? National level estimates, OECD Economics department Working Papers, No 1589.

([77]) Such swings lead to changes in the allocation of resources between tradable and non-tradable sector which can hurt potential growth, erode competitiveness and widen intra-EA imbalances. See Rey, H. (2012). The Euro's Three Crises: *Brookings Papers on Economic Activity*, 43 (1), 219–26.

([78]) Frayne, Ch., A. Szczypińska, B. Vašíček and S. Zeugner (2022). Housing Market Developments in the Euro Area: Focus on Housing Affordability, European Economy – Discussion Papers, forthcoming.

III. The exchange rate elasticity of import prices across the euro area

By Eric Meyermans

***Abstract**: This section examines the responsiveness of the aggregate price of goods imported from outside the euro area to nominal exchange rate fluctuations across the euro area. It presents estimates of price to exchange rate elasticities disentangling the effects of the bilateral euro exchange rate against the US dollar, and the euro nominal effective exchange rate against a basket of currencies of non-euro EU Member States and a basket of the currencies of a selected group of other countries. The empirical analysis suggests that the overall exchange rate pass-through differs significantly across euro area Member States. As expected, the magnitude of the elasticities is lower in the short term than in the long term for most Member States. In the long term, the point estimates of the production costs of the imported goods and exchange rate are similar in line with economic theory, but in the short term the point estimates for the former tend to be larger than those for the latter. Finally, the US dollar affects the aggregate import price of goods primarily through the import of oil in most Member States ([79]).*

III.1. Introduction

This section examines the impact of euro exchange rate changes on the aggregate price of goods imported from outside the euro area across the euro-area countries. The speed and magnitude of the exchange rate pass-through of a change in a foreign currency is mainly conditioned by market structure, macro-economic conditions and the share of the imports denominated in that currency in total imports. This pass-through has a direct impact on Member States' inflation and external adjustment capacity. It also affects the speed of convergence in the euro area ([80]).

This section is organised as follows. The second subsection presents a brief literature review of the macroeconomic effects of (in)complete exchange rate pass-through to import prices, while the third subsection identifies the factors affecting this pass-through. Building on this literature review, the fourth and fifth subsections provide new empirical estimates of euro-area countries' exchange rate pass-through. The last section draws some conclusions.

International trade takes place in various currencies. However, the volatility of these currencies' exchange rates against the euro may differ, affecting the speed and magnitude of the pass-through ([81]). Moreover, international trade in oil and other commodities is predominantly invoiced in US dollars, reflecting the dollar's strong international currency status.

The empirical analysis in this section therefore adds to the existing empirical literature (to the best of our knowledge) two novel features. First, it makes a distinction between the euro's exchange rate against the US dollar, a basket of non-euro EU Member States' currencies and a basket of the currencies of a selected group of other countries ([82]). Second, the price of oil and non-fuel commodities denominated in US dollars are taken into account as separate channels. The resulting empirical analysis suggests that these two features may help to better understand cross-country differences in exchange rate pass-through ([83]).

([79]) The author wishes to thank an anonymous reviewer for useful comments. This section represents the author's views and not necessarily those of the European Commission.

([80]) Convergence in the euro area is a multi-dimensional process, whereby nominal, real, social, cyclical convergence and convergence towards resilient economic structures are different but relevant and interrelated dimensions. See for instance Berti, K. and E. Meyermans (2017), 'Sustainable convergence in the euro area: A multi-dimensional process', *Quarterly Report on the Euro Area*, Vol. 17, No.3, pp. 9-24.

([81]) See subsection III.3 for more details.

([82]) In the following econometric analysis this level of aggregation helps to avoid problems related to multicollinearity (especially for non-euro area EU exchange rates) and to maintain sufficient degrees of freedom when estimating - which could decrease significantly if a further disaggregation of the basket of the currencies of a selected group of other countries would were considered.

([83]) This section has been prepared against the backdrop of an appreciating US dollar in the wake of the Russian invasion of Ukraine. Various factors may affect the exchange rate pass-through of such a strengthening of the dollar on import prices, including its expected persistence, and changes in the pricing power of importers and in invoice currency composition. However, as the sample of the econometric regression analysis of this section does not cover the first nine months of 2022, inferring the quantitative impact of this strengthening on import prices would be beyond the scope of this section.

III.2. The macroeconomic effects of the exchange rate pass-through to import prices: a short overview

The literature identifies several channels through which the intensity of the exchange rate pass-through to import prices may affect a country's inflation and external adjustment capacity, as well as convergence in a currency union.

III.2.1. Inflation

The exchange rate pass-through to import prices affects consumer price inflation through several channels, including the following.

- *Direct effects:* as some imported products constitute part of the consumption bundle of households, changes in import prices caused by an exchange rate change may have a direct effect on the consumer price index.

- *Input-output effects*: imported goods such as oil may serve as intermediate inputs into the domestic production of products for households so that changes in the prices of imported intermediate inputs (following an exchange rate change) may also affect consumer prices.

- *Substitution/demand effects*: a depreciation may reallocate consumption away from imported products towards domestic products as imported goods become more expensive ([84]). Such increased domestic demand may put additional pressure on consumer prices.

A lower pass-through also allows monetary policy to focus more on domestic sources of inflationary pressures ([85]).

III.2.2. External adjustment capacity

In the case of a full and immediate pass-through, a depreciation will trigger a trade surplus if import and export volumes are very price responsive – so that the Marshall-Lerner conditions hold ([86]).

An incomplete exchange rate pass-through to import prices will also affect a country's external adjustment capacity also through its impact on the relative price of traded and non-traded goods and of exports and imports (denominated in local currency) ([87]).

In an extreme case of no exchange rate pass-through to import or export prices ([88]) there will be no change in imported and exported volumes when the exchange rate changes. However, the terms of trade will be affected as the country's export prices (denominated in local currency) will increase ([89]) while import prices will remain constant, so that the nominal trade balance will improve.

In the case of a partial pass-though to import prices, the impact of an exchange rate change on import volumes will be smaller than in a complete pass-through scenario, as foreign exporters absorb a portion of the shock into their margins. However, trade volumes will change and, depending on the size of trade elasticities, the terms of trade changes ([90]) and links between imports and exports ([91]), impose a heavier adjustment burden on the nominal exchange rate to restore external equilibrium (Gust et al. (2008) and Obstfeld and Rogoff (2004) ([92])).

III.2.3. Speed of convergence

Significant cross-country differences in exchange rate pass-through to import prices within a currency union such as the euro area may also

([84]) Complementarity between imported and domestic goods may have the opposite effect.

([85]) Cœuré, B. (2017), 'The euro's global role in a changing world: a monetary policy perspective', speech delivered at the Council on Foreign Relations, New York City, 15 February 2019.

([86]) Tthe sum of import and export price elasticities (in absolute value) is greater than one. See Grubel, H. (1990), *International Economics*, Richard D. Erwin Inc.

([87]) For a more detailed analysis see Gust, C., Leduc, S. and N. Sheets (2008), 'The Adjustment of Global External Balances: Does Partial Exchange Rate Pass-Through to Trade Prices Matter?', *Federal Reserve Bank of San Francisco Working Paper Series* No. 2008-16, and Tille, C. (2007), 'Box 3.3. Exchange Rate Pass-Through to Trade Prices and External Adjustment' in IMF (2007), *World Economic Outlook, April 2007*.

([88]) Traded goods prices are set in the currency of the buyer, i.e. local currency pricing.

([89]) In line with the depreciation and constant price in foreign currency in the export market.

([90]) Partly conditioned by the pass-through on the export side.

([91]) The adjustment burden may be heavier if imports are required for exports and export demand shows low price elasticity.

([92]) Obstfeld, M. and K. Rogoff (2004), 'The Unsustainable US Current Account Position Revisited', *National Bureau of Economic Research (NBER) Working Paper* No. 1086. Gust et al. (2008), *op. cit.*

deepen divergence between inflation rates in the currency union if hit by a persistent exogenous exchange rate shock ([93]). It may also create a wide gap between Member States' capacity to withstand a common real shock as they may have different needs for a euro exchange rate adjustment, depending on their pass-through intensity ([94]). Such divergent responses may make the common monetary policy less effective.

III.3. Factors affecting the exchange rate elasticity of import prices: a short literature review

In perfectly competitive markets, exchange rate movements are immediately fully passed on to import prices and the law of one price holds. However, depending on market structure and macroeconomic conditions, the literature identifies several channels that may hinder a full exchange rate pass-through to import prices. These channels can be briefly summarised as follows.

III.3.1. Market structure

In imperfect markets several features will affect the exchange rate pass-through, including the following.

- *Substitutability and market integration*: in markets characterised by strong substitutability with domestically produced goods, no barriers to restrict spatial arbitrage and no market entry barriers, the exporters usually act as price takers and set their prices accordingly. If there is imperfect competition in international markets, the exchange rate pass-through is incomplete as companies trade off changes in profits with changes in sales when the exchange rate changes (e.g. Dornbusch (1989) ([95])).

- *Choice of invoice currency:* if the imports are invoiced in the currency of the importer, the importer's price will not be affected by a subsequent exchange rate change, and the exporting producer's profit margin (measured in foreign currency) will shrink (Krugman (1987) ([96])). If imports are invoiced in the producer's currency, the importer has to pay a higher price if the currency depreciates (Obstfeld and Rogoff (1995) ([97])). Similarly, if imports are invoiced in a dominant currency, importers have to bear the burden of the adjustment, even if the exporter's profits do not necessarily increase (Goldberg and Tille (2008) ([98])).

Several factors may affect the choice of the invoice currency. They may also affect the speed and size of the exchange rate pass-through ([99]).

- *Type of good:* when international trade in homogeneous goods whose prices are set in global markets, such as oil and raw materials, or goods produced by specific sectors such as the aircraft and energy sectors, is mainly invoiced and settled in US dollars. In this case the speed and size of the exchange rate pass-through is usually high and its size is large (Tille and Goldberg (2009) ([100]) and Langedijk et al. (2016) ([101])).

- *International trade openness:* a more open economy makes exporters more responsive to their competitors' price-setting. This may delay the pass-through (López-Villavicencio and Mignon (2021) ([102])) and Gust et al. (2008) ([103])). Closely related to this is the stability of the invoice currency, as it may reduce exchange rate risks.

([93]) Leiva-Leon, D., Martínez-Martín, J. and E. Ortega (2020), 'Exchange rate shocks and inflation comovement in the euro area', *ECB Working Paper Series* No.2383, estimate that exogenous shocks to the exchange rate were behind more than 50% of nominal EUR/USD exchange rate fluctuations in more than a third of the quarters between the first quarter of 2013 and second quarter of 2019.

([94]) In addition to other structural factors such as differences in import composition and import price elasticities.

([95]) Dornbusch, R. (1987), 'Exchange rates and prices', *American Economic Review*, Vol. 77, No. 1, pp. 93–106

([96]) Krugman, P (1987), 'Pricing to Market When the Exchange Rate Changes', *NBER Working Paper* No. 1926.

([97]) Obstfeld, M. and K. Rogoff (1995), 'Exchange Rate Dynamics Redux', *Journal of Political Economy*, Vol. 103, pp. 624-660

([98]) Goldberg, L. and C. Tille (2008), 'Vehicle currency use in international trade', *Journal of International Economics*, Vol. 76, No. 2, pp. 177-192.

([99]) Although in the long term (in the absence of any frictions) the law of one price holds so that the exchange rate and import price are simultaneously determined and keep pace with the exporters' production costs.

([100]) Tille, C. and L. Goldberg (2009), 'What drives the invoicing of international trade?, *VoxEU*. 2 Dec 2009.

([101]) Langedijk S., Karagiannis S. and E. Papanagiotou (2016), 'Invoicing Currencies in International Trade - Drivers and Obstacles to the Use of the Euro', *JRC Science for Policy report.*

([102]) López-Villavicencio, A. and V. Mignon (2020), 'On the Seemingly Incompleteness of Exchange Rate Pass-Through to Import Prices: Do Globalization and/or Regional Trade Matter?', in Recent Econometric Techniques for Macroeconomic and Financial Data, Dynamic Modeling and Econometrics in Economics and Finance 27

([103]) Gust, C., Leduc, S. and N. Sheets (2008), *op. cit.*

- *Global value chains:* companies in global value chains may have a strong incentive to settle their imported inputs in dollar when selling in dollars in order to stabilise their margins (Tille et al. (2021) ([104])). In this case, the domestic currency does not play its role as a unit of account or medium of exchange, making the concept of pass-through to import prices redundant.

- *International currency status:* a strong international currency status makes for low transaction costs and a low exchange rate risk for both exporters and importers. This means that the imports of countries with a strong currency stratus are more likely to be invoiced and settled in their own currency, making their import prices less sensitive to exchange rate fluctuations.

- *Company size:* smaller companies are more likely to adopt the invoicing currency of their main competitors (Tille and Goldberg (2009) and Langedijk et al. (2016)). As a result, insofar as a country imports only from small companies it will be able to settle its international trade in local currency, making its imports less sensitive to exchange rate fluctuations.

III.3.2. Macroeconomic conditions

The degree of exchange rate pass-through to import prices may also be affected by macro-economic conditions, including the following.

- *Business cycle:* a booming economy may create more room to increase prices. This may speed up the exchange rate pass-through (Ben Cheikh et al. (2018) ([105])).

- *Nature of the exchange rate shock:* the size and expected duration of the exchange rate change may also affect the pass-through with big changes and depreciations (expected to be persistent) more likely to be passed through (completely) (Bailliu and Bouakez (2004) ([106])). Even so, the origin of the shock is also important. If an exchange rate change is triggered by a shock to domestic demand, then it is less likely to be passed through than when triggered by a shock originating in the rest of the world (Forbes et al. (2017) ([107])). Exchange rate fluctuations caused by financial market shocks ([108]) are also less likely to be passed on to prices (Rogoff (1996) ([109])).

- *Price stability*: when inflation is low, companies tend to change their prices less frequently, leading to a lower pass-through in the short term (but not in the long term to remain profitable) (Bailliu and Bouakez (2004) ([110]) and Taylor (2020) ([111])).

- *Exchange rate volatility*: countries with low exchange rate volatility or stable monetary policies are more likely to have their currencies chosen for invoicing and settling international trade (Bacchetta and van Wincoop (2003) ([112]). This makes them more likely to have a low pass-through (Gopinath (2015) ([113])) ([114]).

- *Menu costs:* the high fixed costs of implementing a price change may also slow down the exchange rate pass-through, possibly leading to strong non-linearities whereby exchange rate changes are only passed through when they reach a certain threshold (Larue et al. (2010) ([115])).

([104]) Tille, C., Mehl, A., Georgiadis, G. and H. Le Mezo (2021), 'Fundamentals vs. policies: can the US dollar's dominance in global trade be dented?', *Centre for Economic Policy Research (CEPR) Discussion Paper DP16303.*

([105]) Ben Cheikh, N, Ben Zaied, Y., Bouzgarrou, H. and P. Nguyen (2018), 'Nonlinear Exchange Rate Pass-Through: Does Business Cycle Matter?', *Journal of Economic Integration*, Vol.33 No.2, pp. 1234-1261. These authors report a higher pass-through for a positive output gap.

([106]) Bailliu, J. and H. Bouakez (2004), *op. cit.*

([107]) Forbes, K., Hjortsoe, I. and T Nenova (2018), 'The shocks matter: Improving our estimates of exchange rate pass-through', *Journal of International Economics*, Vol. 114, pp. 255–275, argue that in this case companies distributing imported products have less of an incentive to reduce prices, because the increase in domestic prices (corresponding to stronger demand) gives them some leeway to increase margins without losing market share.

([108]) I.e. these shocks do not reflect changes in the real economy, but may affect the relative prices of imported and domestic goods.

([109]) Rogoff, K. (1996), 'The Purchasing Power Parity Puzzle' *Journal, Journal of Economic Literature,* Vol. 34, pp. 647-68.

([110]) Bailliu, J. and H. Bouakez (2004), 'Exchange Rate Pass-Through in Industrialized Countries', Bank Of Canada Review, spring 2004.

([111]) Taylor, J. (2000), 'Low inflation, pass-through, and the pricing power of firms', *European Economic Review*, Elsevier, Vol.. 44, No. 7, pp. 1389-1408,

([112]) Bacchetta, P. and E. van Wincoop (2003), 'Why Do Consumer Prices React Less than Import Prices to Exchange Rates?', *Journal of the European Economic Association*, Vol. 1, No. 2-3, pp. 662-670.

([113]) Gopinath, G. (2015), 'The International Price System', *NBER Working Paper* No. 21646.

([114]) Up to 2 years.

([115]) Larue, B.Gervais, J-P and Y. Rancourt (2010), 'Exchange rate pass-through, menu costs and threshold cointegration', *Empirical Economics*, Vol. 38, pp. 71–192.

III.4. Estimates of the exchange rate elasticities of import prices

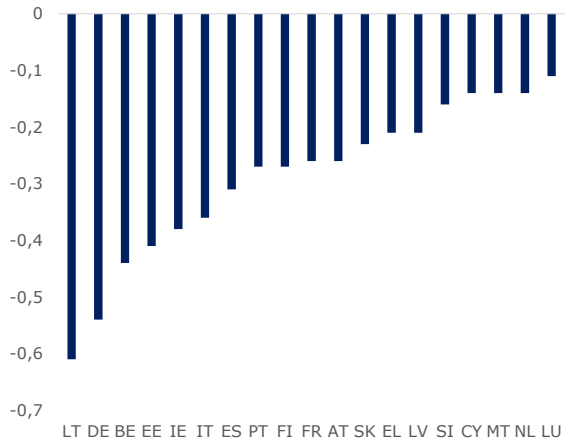
III.4.1. A first look at the data and literature

Figure III.1 shows the unconditional correlation between the aggregate price of goods imported from outside the euro area and the corresponding nominal effective exchange rate for each of the euro-area countries between the third quarter of 2003 and the third quarter of 2021. These correlations seem to suggest that there may be some significant differences in Member States' responsiveness to exchange rate changes.

These correlations are in line with results from available studies suggesting that at the aggregate level, the nominal exchange rate pass-through to import prices is well below unity across advanced economies, and that estimates sometimes vary a lot across countries and periods. For example, the Bank of England (2015) ([116]) estimates that the pass-through from exchange rate movements to UK import prices is about 60%. Berner (2010) ([117]) estimates for Germany a pass-through rate of about 42% in the short term of 3 months and 46% in the long term of 9 months. Fisher (2015) estimates the pass-though to non-oil imports at about 30% for the US. In their seminal paper, Campa and Goldberg (2005) ([118]) provide a broad range of estimates of short-term elasticities for euro-area countries from 0.16 in Ireland to 0.79 in the Netherlands, and of long-term elasticity from 0.06 in Ireland to 0.98 in France.

This subsection presents estimates of the sensitivity of the aggregate price of goods imported from outside the euro area to changes in various nominal (effective) exchange rates across the euro area. These estimates are obtained by estimating an error correction mechanism for each of the Member States separately. The sample covers the period from the first quarter of 2003 until the third quarter of 2021.

Graph III.1: **Correlation between import prices and exchange rates**
(quarter-on-quarter changes for 2003Q3-2021Q3)



(1) Aggregate price of goods imported from outside the euro area and the corresponding nominal effective exchange rate measured as the number of units of foreign currency per euro, so that a rise in the exchange rate indicates an appreciation of the euro and a decrease a depreciation.

Source: Author's estimates using Eurostat International trade in goods statistics data and data from the ECB Statistical Warehouse.

III.4.2. A reduced form regression analysis

The aggregate price of goods imported from outside the euro area is regressed on the euro exchange rate of a basket of non-euro EU countries' currencies ([119]), the US dollar and a basket of the currencies of selected group of other countries ([120]). Such a disaggregation of the nominal effective exchange rate allows for cross-currency differences in the exchange rate pass-through ([121]). Such differences may be due to differences in transaction costs, exchange rate risks, or exporters' price setting.

Other factors expected to affect the price of goods imported from outside the euro area are exporters' costs (measured by unit labour costs denominated in the currency of the exporter), the price of oil and non-fuel commodities (denominated in US dollars), and the domestic output gap as exporters (or

([116]) Bank of England (2015), *Inflation Report*, November 2015.
([117]) Berner, E. (2010), 'Exchange rate pass-through: new evidence from German micro data', *Économie internationale*, No 124, pp. 75-100.
([118]) Campa, J. and L. Goldberg (2005), 'Exchange Rate Pass-Through into Import Prices', *The Review of Economics and Statistics*, Vol. 87, No. 4, pp. 679-690.
([119]) Using import weights retrieved from the ECB Statistical Warehouse.
([120]) Australia (AU), Canada (CA), Switzerland (CH), Japan (JP), Norway (NO), New Zealand (NZ) and the United Kingdom.
([121]) Including various exchange rates in the regression analysis could create problems of multicollinearity that may increase the standard error of the point estimates. However, as discussed in Box III.1 for this exercise the problem of multicollinearity seems to be limited.

companies distributing imported goods ([122])) may set their prices taking into account overall macroeconomic developments in their export market.

Imports settled in several currencies may also have a different impact on aggregate import prices, arising not only from differences in their share of total imports, but also from the share of the currency used for invoicing.

In the subsequent regression analysis a significant difference between the long- and short-term equations is the type of restrictions imposed on the parameters associated with exchange rates and exporters' production costs. The parameters in the long-term equation are expected to be more homogeneous than the parameters in the short-term equations – as discussed below. See Box III.1 for more technical details on the estimation strategy.

III.4.3. The equilibrium relationship

To obtain the point estimates for the long-term exchange rate elasticities of the price of goods imported from outside the euro area, a long-term equilibrium equation (1) in Box III.1 has been estimated for each euro-area Member State separately. The point estimates for these elasticities (and their significance) as well as some diagnostic statistics are shown in Table B in Box III.1 and summarised in the upper pane of Graph III.2.

However, before discussing these point estimates, it should be borne in mind that a set of diagnostic statistical tests support the hypotheses that (i) the effect of the exchange rates on the prices of imported goods is economically meaningful over time; (ii) the import prices take equal account of changes in production costs and exchange rate movements; and that (iii) there are significant differences in the exchange rate elasticities of import prices across countries..

- *Cointegration*: the null hypothesis that the time series constituting the long-term equation are not cointegrated ([123]) is tested using Engle-Granger z-statistics. These tests suggest that this null hypothesis may be rejected without additional exogenous variables for most countries, or after adding a deterministic trend or squared trend for other countries. (See also Table B in Box III.1).

- *Homogeneity*: the null hypothesis that in the long term import prices take equal account of changes in production costs and exchange rate movements ([124]) is tested using a Wald F-statistics (in Table A in Box III.1). In most cases, this null hypothesis ([125])cannot be rejected ([126]). A notable exception is the restriction of long-term homogeneity between US dollars and US producer costs in Germany, Spain, Malta and Slovenia. For the countries for which this homogeneity restriction can be rejected, the long-term relation is re-estimated without the restriction (Table B in Box III.1).

- *Cross-country equality*: The confidence levels (based on likelihood ratio tests) at which the null hypothesis that (the sum of) the long-term exchange rate elasticities of import prices are the same (all possible combinations of two) across euro-area Member States are shown in the upper pane of Table E in Box III.1. These results suggest that the null hypothesis of the equality of long-term elasticities can be rejected for most country combinations at a fairly high confidence level.

III.4.4. The short-term dynamics

The short-term equation in first differences (quarter-on-previous-quarter) and with a (one quarter-lagged) error correction term ([127]), i.e. equation (2) in Box III.1, is estimated (i) without any restrictions on the parameters of the exchange rate or producer costs, but (ii) with the restriction that the price of oil and non-fuel commodities are immediately fully settled at the US dollar-euro exchange rate. This specification reflects the

([122]) See Colavecchio, R. and I. Rubene (2020), 'Non-linear exchange rate pass-through to euro area inflation: a local projection approach', *ECB Working Paper Series* 2362 for the impact of market power in the domestic transportation and storage sectors.

([123]) Cointegration is a statistical property whereby variables move (slowly) in similar but not identical ways, with the distance between them stationary. Cointegeation is a precondition for avoiding picking up any spurious correlation in regression analysis. See Engle, R. (2003), 'Time series analysis, cointegration, and applications', Nobel Lecture, December 8, 2003.

([124]) In equation (1) in Box III.1 the restrictions that $\alpha_{1i} = -\alpha_{2i}$ is imposed.

([125]) Technically speaking, the null hypothesis is that the parameter value of the exchange rate is equal to minus the parameter value of the production cost for each of the regions i=NEA, US and ROW.

([126]) Table 1 in Box III.1.

([127]) Using the error term of the long-term equation.

assumption that production costs and exchange rates show different short-term dynamics for goods, other than basic commodities. See Box III.1 for more details and point estimates.

Before discussing the point estimates shown in Table C of Box III.1 and summarised in the second pane of Graph III.2, note that the following hypotheses have been tested.

- *Uniformity:* The short-term equation has been tested for the null hypothesis that the parameters of the three effective exchange rates are the same within a Member State ([128]). This null hypothesis can be rejected at a fairly high confidence level for most of the euro area Member States ([129]). This suggests that the use of a single aggregate nominal effective exchange rate may be too restrictive when estimating the pass-through of exchange rate changes to import prices ([130]). A similar restriction ([131]) applies to the parameters of the production costs.

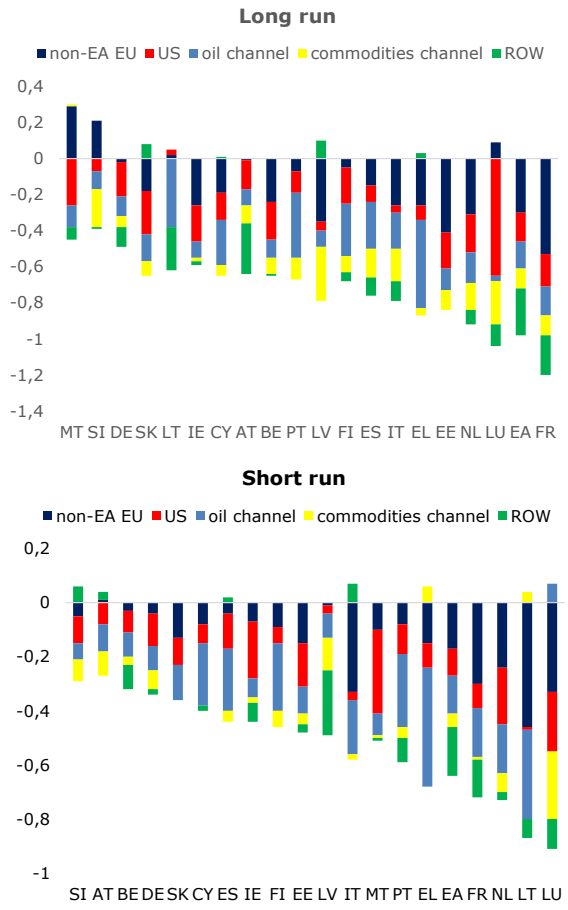
- *Cross-country equality:* The second pane of Table E in Box III.1 shows the confidence levels at which the null hypothesis that (the sum of) the short-term exchange rate elasticities of import prices are the same across Member States. These tests suggest that this null hypothesis can be rejected in a fairly high number of cases, but fewer cases than for the long-term elasticities (shown in the first pane).

III.5. The overall exchange rate pass-through

By stacking the five exchange rate channels ([132]) into one bar, the first and second pane of Graph III.2 show the magnitude of, respectively, the total long- and short-term exchange rate pass-through to the price of goods imported from outside the euro area.

The total length of each stacked bar provides an estimate of the total pass-through of a 1% change in all exchange rates at the same time ([133]). In perfect markets, one would expect that this value (in absolute terms) would be equal to one. All countries except France show an absolute value less than one for the long term.

Graph III.2: **Long- and short-term pass-through: decomposition along currencies**
(scales vary)



(1) A 1% change in all exchange rates at the same time.

Source: Author's estimates – Table B and C in Box III.1

Comparing the estimates for the long-term pass-through (first pane of Graph III.2) with those for the short-term pass-through (second pane of Graph III.2) indicates that as expected, the latter

([128]) I.e. in equation (2) in Box III.1 the restriction $\beta_{11} = \beta_{12} = \beta_{13}$ for the exchange rates is imposed while each log change in the exchange rate is multiplied by its weight in total imports.

([129]) See the p-values related to the likelihood ratio tests reported in Table C of Box III.1.

([130]) The point estimates for the aggregate nominal effective exchange rate are shown as a memo item in Table C in Box III.1.

([131]) I.e. in equation (2) in Box III.1 the restriction $\beta_{21} = \beta_{22} = \beta_{23}$ for the production costs is imposed while each log change in production costs is multiplied by its weight in total imports.

([132]) I.e. the non-euro area EU effective exchange rate, the US dollar related to US production costs, oil prices and prices of non-fuel commodities and the effective exchange rate with the rest of the world.

([133]) This 1% change is illustrative, to facilitate the interpretation of the point estimates.

are smaller (in absolute terms) ([134]) than the former for most Member States (notable exceptions are Malta and Slovenia) ([135]).

These differences show that it takes time before an exchange rate change is fully transmitted to import prices. This may reflect menu costs when setting import prices, as well as pricing and invoicing in euro's in medium and long-term contracts ([136]).

III.5.1. The components of the exchange rate pass-through

Looking at the specific components of the total pass-through, it should be noted that for the long- and short-term responsiveness to changes in the US dollar (red bar) ([137]), all the point estimates have the expected negative sign, are significant for most countries, and that the absolute value of the short-term elasticity is smaller than the long-term elasticity for most countries. All the point estimates for the impact of changes in the US dollar by way of the oil channel (blue bar) also have the expected sign and are almost all significant ([138]), while the short-term elasticities are smaller (in absolute terms) than the long-term ones. Comparing the point estimates for the dollar exchange rate impact on import prices by way of the oil channel (blue bars) with those by way of US production costs (red bars) suggests that the impact of US dollar changes is greater by way of the former than the latter channel in most Member States.

The short- and long-term responsiveness of import prices to change in the nominal effective exchange rate against a basket of non-euro EU currencies (black bar) have all the expected signs (except for Malta, Slovakia and Slovenia) and the short-term elasticity is smaller (in absolute terms) than the long-term elasticity in most cases.

([134]) As the exchange rates are measured as the number of units of foreign currency per euro, a rise in the exchange rate indicates an appreciation of the euro and a decrease a depreciation.

([135]) In the cases of Malta and Slovenia the elasticity of their nominal effective exchange rate against the basket with currencies of the non-euro EU countries has the "wrong" sign distorting its ranking. It would be beyond the scope of this section to identify the causes of this statistical result. Generally speaking, Campa and Goldberg (2005), op. cit. report that smaller European countries typically have noisier and less stable pass-through rates.

([136]) However, in some cases, in the long term a country may find more substitutes to meet its demand, with the result that the long-term elasticity may be lower than the short-term elasticity.

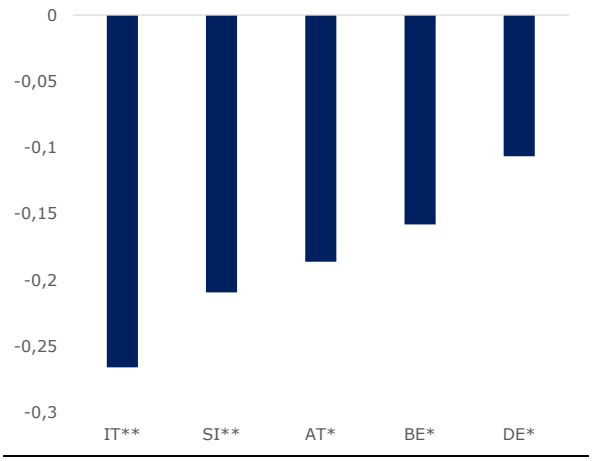
([137]) These estimates do not include the effects of the import of oil and non-fuel commodities.

([138]) A notable exception is the short-term elasticity for Luxembourg.

The elasticities for the nominal effective exchange rate covering the rest of the world (green bar) are (in absolute value) smaller than the ones reported for the US dollar and the effective exchange rate against the non-euro area countries. Albeit insignificant, the point estimates for some Member States show a positive value.

While the impact of production costs and of exchange rate changes are rather homogeneous in the long term for each of the currencies in question ([139]), the point estimates in Table C of Box III.1 suggest that the impact of production costs tends to be greater than the that of exchange rate changes in the short term.

Graph III.3: **Large changes in relation to the US dollar**



(1) A strong change is defined as a change in absolute terms larger than the standard deviation of changes over the sample period.

Source: Author's estimates.

III.5.2. Variable response intensity

The previous results suggest that in the short term all kinds of rigidities may hinder a full exchange rate pass-through. This may occur the costs of adjusting import prices are high. The short-term equation has therefore ben estimated making a distinction between small and large exchange rate changes ([140]). However, the results show that, in the case of a large exchange rate change, for only a

([139]) As tested in Subsection II.4.3.

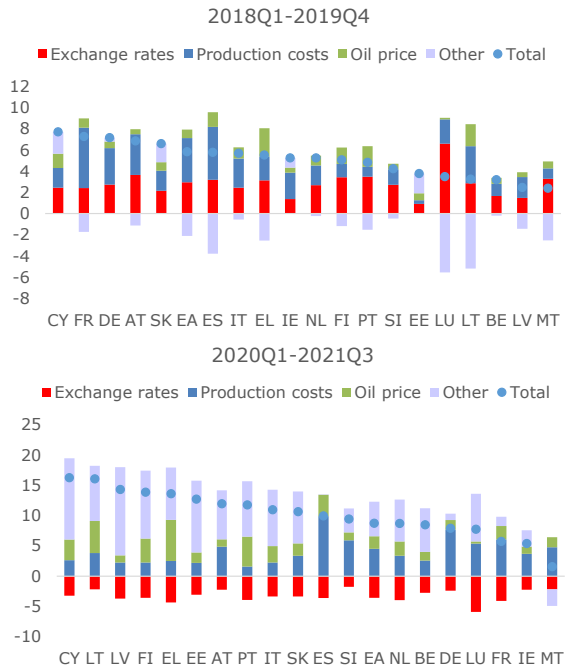
([140]) A large exchange rate change is defined as a change larger than one standard deviation of the changes in the exchange rate time series. This section only shows the results for strong changes in relation to the US dollar. No significant point estimates were obtained for the other currencies in question. A further analysis of whether or not there is an asymmetry between a positive and negative change did not yield significant results.

few countries a significant additional pass-through to short-term elasticity could be found, i.e. Italy, Slovenia, Austria, Belgium and Germany (see Graph III.3). The largest additional significant effect is to be found for Italy and the smallest for Germany, suggesting that for Italy, in the case of a large exchange rate shock, 25% more of the exchange rate change is passed through to import prices in the short term than in the case of a small shock.

III.5.3. The relative importance of exchange rate changes: illustrative breakdown

To get a better understanding of the relative importance of the impact of exchange rate changes on the prices of goods imported from outside the euro area, the upper pane of Graph III.4 shows a breakdown of the total change in import prices into its various components for the period from the first quarter of 2018 until the fourth quarter of 2019.

Graph III.4: **Breakdown of import prices**



(1) For each factor the observed quantity is multiplied by the corresponding point estimate in Table B of Box 1. 'Other' includes the output gap, global financial crisis and COVID-19 dummies, and the random component.

Source: Author's estimate.

Changes in exporters' production cost were the most significant factor determining the increase in import prices for most countries. This explains on average 50% of the change in import prices ([141]). The impact of exchange rate fluctuations (red bars) was fairly modest in Ireland and oil prices had a relatively strong impact in Greece and Lithuania.

The breakdown in the lower pane of Graph III.4 suggests that exchange rate fluctuations (red bars) had only a minor impact on import prices during the COVID-19 pandemic, albeit a tempering (negative) one compared with the strengthening positive) impact in the years before the pandemic.

III.6. Conclusions

The empirical analysis in this section suggests that the euro exchange rates have a significant impact on the price of imported good across the euro area, but this pass-through is not complete and the short-term pass-through is lower than the long-term one.

It also suggests that the overall exchange rate pass-through differs significantly across euro-area Member States. For instance the long-term pass-through in Germany is somewhat more than half the size of the pass-through in France, and the pass-through in the smaller Member States also caries a lot. At the same time, the short- and long-term exchange rate pass-throughs are well below unity in most Member States, and in some smaller Member States the short-term pass-through is higher than the long-term pass-through.

However, within-sample simulations show that exchange rate changes affected national import prices the same way across all euro- area countries, i.e. increasing import prices in the 2 years before the COVID-19 pandemic, but lowering them during the pandemic.

This section did not quantify how these differences may affect a country's inflation rate and external adjustment capacity. However, it should be kept in mind that euro exchange rate adjustments are a less effective way of absorbing common shocks as long as these differences persist. It would be beyond the scope of this section to identify the structural factors at national level that may explain these differences in elasticity.

([141]) Highest in Lithuania, lowest in Estonia.

Box III.1: The exchange rate elasticity of the import prices of goods imported from outside the euro area – a reduced form regression

Specification

The short economic literature review in Sub-section III.3 suggests that the price of identical goods in different markets may differ due to all kinds of market imperfections and macroeconomic conditions. As a result, the exchange rate elasticity of the import prices of goods imported from outside the euro area has been estimated using an error correction mechanism for each of the euro area countries separately.

Three areas from which goods are imported into the euro area countries are considered, i.e. the non-euro EU countries (non-EA EU), the United States (US) and the rest of the world (ROW). The long-term equation links the price of goods imported from outside the euro area (PM denominated in euro) to the exchange rates (ER) and production costs (PC denominated in foreign currency) of the trading partners in quarter t ([1]) as:

$$(1) \qquad ln(PM_t) = \alpha_0 + \sum_{i=1}^{3} \alpha_{1i} ln(ER_{i\,t}) + \sum_{i=1}^{3} \alpha_{2i} ln(PC_{i\,t}) + \alpha_3 ln\left(\frac{P\_OIL_t}{ER_{US\ t}}\right) + \sum_{l=1}^{m} \alpha_{4l} X_{lt} + u_t$$

where ER measures the number of foreign currency units per euro; P_OIL is the oil price ([2]); X covers all other relevant variables, u is a stochastic term, and $\alpha_{1i} < 0$ and $\alpha_{2i} > 0$.

The short-term equation reads as:

$$(2) \qquad \Delta ln(PM_t) = \beta_0 + \sum_{i=1}^{3} \beta_{1i} \Delta ln(ER_{i\,t}) + \sum_{i=1}^{3} \beta_{2i} \Delta ln(PC_{i\,t}) + \beta_3 \Delta ln\left(\frac{P\_OIL_t}{ER_{US\ t}}\right) + \sum_{l=1}^{n} \beta_{4l} \Delta X_{lt} + \beta_5 ECT_{t-1} + w_t$$

where w is a random component, ECT is the error correction term obtained from equation (1), and $\beta_{1i} < 0$ and $\beta_{2i} > 0$.

In the empirical analysis, the production cost is measured by the nominal unit labour cost (denominated in the currency of the exporter). For the homogeneous commodities traded on world markets, such as oil and non-fuel commodities, the exchange rate pass-through is assumed to hold immediately, i.e. specified as an explanatory variable as $ln\left(\frac{P_{oil}}{ER_{US}}\right)$ and $ln\left(\frac{P_{non\ -fuel\ \ commodity}}{ER_{US}}\right)$. X also includes the output gap of the importing country, as exporters' price mark-up depends to some extent on the local business cycle.

Data

The harmonised data on imports of goods from outside the euro area are retrieved from the Eurostat international trade in goods statistics (ITGS) database (series ei_eteu27_2020_m). 'Goods' refers to all movable property including electricity. The ITGS database follow the physical movements of the goods (except for some specific goods like vessels and aircraft). The European ITGS database constitutes an essential source of information for compiling statistics on the balance of payments and national accounts, but comparability across domains is affected by differences in concepts and definitions ([3]). The ITGS database reports the value and a quantity index of goods imported from outside the euro area ([4]). The import price is obtained by dividing the value by quantity variables and normalising it with reference year 2015 ([5]).

Data on the price of oil and non-fuel commodities are retrieved from the IMF primary commodity prices database. The bilateral exchange rates are obtained from the ECB Statistical Warehouse. The unit labour

([1]) A similar specification has been proposed by Campa and Goldberg (2005), *op. cit.*
([2]) It is assumed that the price of oil is set in US dollar.
([3]) For instance, for the ITGSdatabase international trade comprises the application of the principle of physical movements across national frontier, and for the balance of payments/national accounts statistics the change of economic ownership between residents and non-residents. See https://ec.europa.eu/eurostat/cache/metadata/en/ei_et_esms.htm for more details.
([4]) The monthly frequency is converted to a quarterly frequency by summing the values and averaging the quantity indices.
([5]) The euro area aggregates are obtained for the indicator in current prices by summing the corresponding variable across all euro area countries, and for the quantities by calculating the weighted average of the corresponding indicator for the euro area countries.

(Continued on the next page)

Box (continued)

cost data for the EU Member States are retrieved form the Eurostat national accounts, while those for the non-EU countries are retrieved from OECD Statistics.

Estimation results

The equations are estimated by applying ordinary least squares, i.e. the empirical analysis adopts a partial-equilibrium approach in that it assumes predetermined nominal exchange rate fluctuations, production costs and oil prices (measured in US dollars ([6]). Table A shows the F-Statistics p-values for the null-hypothesis that $\alpha_{1i} = -\alpha_{2i}$ ([7]) in the long-term equation (1). When the null-hypothesis can be rejected at a 0.05 or higher confidence level, Table B shows point estimates for the long-term equation (1) with the condition $\alpha_{1i} \neq -\alpha_{2i}$. ([8]) The absence of cointegration of the long-term relationship (1) is tested using the Engle-Granger cointegration z-statistic - shown in the last row of Table 2. The null hypothesis of no cointegration could be rejected for all Member States – in some case after adding a deterministic trend.

Table C shows point estimates for the short-term equation (2). The row with likelihood ratio p-values refers to the null-hypothesis that the point estimates for the exchange rate, i.e. $\beta_{11} = \beta_{12} = \beta_{13}$, and point estimate for the unit labour cost, i.e. $\beta_{21} = \beta_{22} = \beta_{23}$, are the same. The R-squared statistics are fairly high (except for Luxembourg and Ireland), while the Durbin-Watson tests tend to be inconclusive for some countries ([9]).

Table A –Parameter restrictions: F-statistics p-values

	NEA	US	ROW		NEA	US	ROW
EA	0,196	0,646	0,298	LV	0,752	0,169	0,370
BE	0,559	0,154	0,013 **	LT	0,015 **	0,663	0,006 ***
DE	0,773	0,011 **	0,676	LU	0,469	0,259	0,466
EE	0,410	0,459	0,032 **	MT	0,942	0,022 **	0,234
IE	0,743	0,240	0,249	NL	0,169	0,714	0,036 **
EL	0,064 *	0,187	0,169	AT	0,000 ***	0,775	0,019 **
ES	0,164	0,018 **	0,118	PT	0,656	0,964	0,341
FR	0,128	0,768	0,351	SI	0,288	0,000 ***	0,106
IT	0,920	0,081 *	0,453	SK	0,852	0,084 *	0,602
CY	0,422	0,139	0,943	FI	0,072 *	0,459	0,219

Note: The null-hypothesis is in equation (1) $\alpha_{1i} = -\alpha_{2i}$, for i= NEA, US and ROW; * for p<0,1, ** for p<0.05, *** for p<0,01

Table B: Factors affecting import prices – long-term (semi-)elasticities

Dependent variable: natural logarithm of aggregate import price in euro

	EA	BE	DE	EE	IE	EL	ES	FR	IT	CY
Non-EA EU NEER	-0,30	-0,24	-0,02	-0,41	-0,26	-0,26	-0,15	-0,53	-0,26	-0,19
US dollar	-0,16	-0,21	-0,19	-0,20	-0,20	-0,08	-0,09	-0,18	-0,04	-0,15
ROW NEER	-0,26	-0,01	-0,11	0,00	-0,02	0,03	-0,10	-0,22	-0,11	0,01
Non-EA EU production costs (in foreign currency)	***0,30***	***0,24***	***0,02***	***0,41***	***0,26***	***0,26***	***0,15***	***0,53***	***0,26***	***0,19***
US production costs (in US dollar)	***0,16***	***0,21***	0,81	***0,20***	***0,20***	***0,08***	0,96	***0,18***	***0,04***	***0,15***
ROW production costs (in foreign currency)	***0,26***	-0,21	***0,11***	-0,47	***0,02***	***-0,03***	***0,10***	***0,22***	***0,11***	***-0,01***
Price of oil / US dollar	0,15	0,10	0,11	0,12	0,09	0,49	0,26	0,16	0,20	0,25
Price of non-fuel / US dollar	0,11	0,09	0,06	0,11	0,02	0,04	0,16	0,11	0,18	0,06
GFC-dummy	0,03	0,03	0,03	0,04	0,00	0,03	0,02	0,01	0,04	-0,01
COVID-dummy	0,03	0,02	0,03	0,00	-0,04	0,05	-0,05	-0,03	0,00	0,11
Output gap	0,72	0,44	0,75	0,15	0,27	-0,14	-0,10	-0,05	0,34	0,08
Constant	2,63	3,59		4,54	3,19	1,89	-1,60	2,47	2,46	2,47
Trend		0,00		0,00	0,00	0,00	0,00		0,00	0,00
Trend squared					0,00					
Adjusted R-squared	0,99	0,97	0,99	0,97	0,95	0,97	0,98	0,99	0,98	0,95
Total number of observations	73	73	73	73	73	73	73	73	73	73
Total number of explanatory variables	9	11	9	11	11	10	11	9	10	10
Engle-Granger cointegration test: z-statistic	0	0,00	0,04	0,04	0,00	0,01	0,00	0,00	0,00	0,00
Memo item for p-val likelihood ratio test	0.00***	0.00***	0.00***	0.00***	0.00***	NA	0.00***	0.00***	0.00***	0.02**
One effective NEER	-0,25	-0,12	-0,26	-0,03	-0,28	-0,09	-0,10	-0,28	-0,17	-0,05
One effective production cost (in foreign currency)	0,76	0,94	0,97	0,92	0,61	0,40	0,61	1,17	1,04	0,62

Note: Estimates for equation (1). The bold italics point estimates indicate that the long-term homogeneity condition $\alpha_{1i} = -\alpha_{2i}$ holds. NEER is defined as the number of foreign

([6]) Following Dornbusch, R. (1987), 'Exchange rates and prices', *American Economic Review*, Vol. 77, No. 1, pp. 93–106.
([7]) In equilibrium, the import prices take equal account of changes in production costs and exchange rate movements. A negative sign as an increase in the exchange rate means an appreciation of the euro.
([8]) The point estimates for this restrictive version are reported as a memo item in Table B.
([9]) In the presence of autocorrelation, the variance estimates of OLS are biased downward, compromising inference about parameter homogeneity and cross-country equality. Nevertheless, the high point estimates for the coefficients of the error correction term suggest that the import price level adjusts quite quickly, tempering the risk that the short term dynamics are misspecified

(Continued on the next page)

Box (continued)

currency units per euro; a positive (negative) sign of the change in NEER indicates an appreciation (depreciation) of the euro. Non-EA EU covers the non-euro area Member States of the EU, ROW covers AU, CA, CH, JP, NO, NZ and UK. Sample 2003Q1-2021Q3; estimated with OLS. No p-values shown for the point estimates as standard t-statistics are not applicable in case of cointegration estimation. The Engle-Granger cointegration z-statistics shows the confidence level at which the null hypothesis of no cointegration can be rejected. As a memo-item the p-values of the likelihood ratio test shows the confidence level at which the null-hypothesis that the parameters of the three exchange rates, i.e. $\alpha_{11} = \alpha_{12} = \alpha_{13} = \alpha_1$, and corresponding labour unit cost, i.e. $\alpha_{21} = \alpha_{22} = \alpha_{23}, = \alpha_2$ are the same, with the last two rows showing estimates of α_1 and α_2.

Table B (continued): Factors affecting import prices – long-term (semi-)elasticities

Dependent variable: natural logarithm of aggregate import price in euro

	LV	LT	LU	MT	NL	AT	PT	SI	SK	FI
Non-EA EU NEER	-0,35	0,02	0,09	0,29	-0,31	-0,01	-0,07	0,21	-0,18	-0,05
US dollar	-0,05	0,03	-0,65	-0,26	-0,21	-0,16	-0,12	-0,07	-0,24	-0,20
ROW NEER	0,10	-0,24	-0,12	-0,07	-0,08	-0,28	0,00	-0,01	0,08	-0,05
Non-EA EU production costs (in foreign currency)	***0,35***	0,99	***-0,09***	***-0,29***	***0,31***	0,59	***0,07***	***-0,21***	***0,18***	***0,05***
US production costs (in US dollar)	***0,05***	***-0,03***	***0,65***	0,74	***0,21***	***0,16***	***0,12***	0,83	***0,24***	***0,20***
ROW production costs (in foreign currency)	***-0,10***	-0,51	***0,12***	***0,07***	-0,16	-0,44	***0,00***	***0,01***	***-0,08***	***0,05***
Price of oil / US dollar	0,09	0,38	0,03	0,12	0,17	0,09	0,36	0,10	0,15	0,29
Price of non-fuel / US dollar	0,30		0,24	-0,01	0,15	0,11	0,12	0,21	0,08	0,09
GFC-dummy	0,07	0,10	-0,02	0,01	0,02	0,03	0,03	0,04	0,06	0,04
COVID-dummy	-0,01	0,04	0,01	-0,01	0,03	0,03	0,06	-0,07	0,09	0,08
Output gap	0,43	0,48	2,23	0,14	0,32	0,85	0,09	0,31	0,87	0,84
Constant	2,41	1,67	0,51	0,77	3,31	3,49	1,84	-0,63	2,48	1,98
Trend	0,00		0,00	0,00	0,00				0,00	
Trend squared										
Adjusted R-squared	0,94	0,94	0,6	0,85	0,98	0,99	0,91	0,96	0,95	0,97
Total number of observations	73	59	61	74	73	73	60	73	70	73
Total number of explanatory variables	10	10	10	11	11	11	9	10	10	9
Engle-Granger cointegration test: z-statistic	0,00	0,09	0,07	0,01	0,00	0,00	0,03	0,02	0,01	0,00
Memo item for										
p-val likelihood ratio test	0.04**	0.01***	0.00***	0.00***	0.00***	0.00***	0.72	0.00***	0.00***	0.88
One effective NEER	0,04	-0,75	-0,13	-0,04	-0,23	-0,25	0,02	0,14	-0,12	-0,15
One effective production cost (in foreign currency)	0,88	0,78	0,75	0,12	0,44	0,88	0,49	0,43	0,29	0,67

Table C: Factors affecting import prices – short-term (semi-)elasticities

Dependent variable: natural logarithm in first differences of aggregate import price in euro

	EA	BE	DE	EE	IE	EL	ES	FR	IT	CY
Non-EA EU NEER	-0.17 **	-0.03	-0.04	-0.15	-0.07	-0.15	-0.04	-0.30 ***	-0.33 ***	-0.08
US dollar	-0.10 *	-0.08	-0.12 **	-0.16 *	-0.21 **	-0.09	-0.13 *	-0.09	-0.03	-0.07
ROW NEER	-0.18 **	-0.09	-0.02	-0.03	-0.07	0.00	0.02	-0.14 **	0.07	-0.02
Non-EA EU production costs (in foreign currency)	0.22 ***	0.08	0.05	0.06	0.25 *	0.21 **	0.23 **	0.33 ***	0.21 **	0.17
US production costs (in US dollar)	0.41 ***	0.37 **	0.62 ***	0.38	0.45 **	0.45 *	0.73 ***	0.28 *	0.38 *	0.47 **
ROW production costs (in foreign currency)	0.04	-0.10	-0.00	-0.13	0.04	-0.41 **	-0.01	0.09	0.04	-0.02
Price of oil / US dollar	0.14 ***	0.08 ***	0.09 ***	0.11 ***	0.07 ***	0.42 ***	0.23 ***	0.17 ***	0.18 ***	0.23 ***
Price of non-fuel / US dollar	0.04	0.02	0.06 **	0.02	0.00	-0.07	0.01	-0.01	0.01	-0.02
Depreciation v-a-v US	-0.05	-0.16 *	-0.11 *	-0.21	0.03	0.02	-0.08	-0.05	-0.27 **	-0.02
GFC-dummy	0.02 ***	0.03 ***	0.03 ***	0.02 *	0.00	0.01	0.02 **	0.01 *	0.03 ***	0.00
COVID-dummy	0.00	-0.01	0.01	0.01	-0.01	0.04 *	-0.00	0.01	-0.01	0.07 ***
Output gap	0.05	0.06	0.05	0.04	0.02	0.01	0.03	0.04	0.05	0.01
Error correction term	-0.49 ***	-0.57 ***	-0.72 ***	-0.65 ***	-0.42 ***	-0.54 ***	-0.59 ***	-0.41 ***	-0.63 ***	-0.40 ***
Adjusted R-squared	0.86	0.70	0.81	0.67	0.52	0.93	0.87	0.86	0.84	0.81
Durbin Watson	1.68	1.52	1.46	1.34	1.83	2.07	1.53	2.09	2.07	2.06
Total number of observations	71	72	72	72	72	72	72	72	72	72
Total number of explanatory variables	13	13	13	13	13	13	13	13	13	13
Memo item										
p-value likelihood ratio test	0.14	0.20	0.00***	0.15	0.14	0.00***	0.00***	0.00***	0.00***	0.08*
One effective NEER	-0.48 ***	-0.20 **	-0.19 *	-0.13	-0.26 **	0.05	-0.07	-0.35 ***	-0.11	-0.03
One effective production cost (in foreign currency)	0.58 ***	0.20	0.39 ***	0.04	0.43 ***	0.14	0.61 ***	0.68 ***	0.68 ***	0.31 **

Note: Estimation of equation (2). Point estimates with their significance level: * for p<0.10, ** for p<0.05 and *** for p<0.01.
The p-value of the likelihood ratio test shows the confidence level at which the null-hypothesis that the parameters of the three exchange rates, i.e. $\beta_{11} = \beta_{12} = \beta_{13}$, and corresponding labour unit cost, i.e. $\beta_{21} = \beta_{22} = \beta_{23}$, are the same.

(Continued on the next page)

Box (continued)

Table C (continued): Factors affecting import prices – short-term (semi-)elasticities

Dependent variable: natural logarithm in first differences of aggregate import price in euro

	LV	LT	LU	MT	NL	AT	PT	SI	SK	FI
Non-EA EU NEER	-0.01	-0.46 **	-0.33	-0.10	-0.24 ***	0.01	-0.08	-0.05	-0.13 *	-0.09
US dollar	-0.03	-0.01	-0.22	-0.31 ***	-0.21 ***	-0.08	-0.11	-0.10 *	-0.10	-0.06
ROW NEER	-0.24 ***	-0.07	-0.11	-0.01	-0.03	0.03	-0.09	0.06	0.00	0.00
Non-EA EU production costs (in foreign currency)	0.01	0.46 **	-0.05	-0.12	0.16	0.44 ***	0.28 **	-0.15 *	0.11	0.33 **
US production costs (in US dollar)	0.73 **	0.98 ***	1.52 *	1.15 ***	0.50 ***	0.40 **	0.01	0.84 ***	0.43 ***	0.57 ***
ROW production costs (in foreign currency)	-0.17	-0.17	-0.28	0.30 *	-0.04	-0.21	0.19	-0.58 ***	-0.10	-0.10
Price of oil / US dollar	0.09 ***	0.33 ***	-0.09	0.09 ***	0.17 ***	0.10 ***	0.28 ***	0.06 ***	0.13 ***	0.25 ***
Price of non-fuel / US dollar	0.07	-0.07	0.20	-0.04	0.04	0.07	0.02	0.05	-0.02	0.04
Depreciation v-a-v US	-0.14	-0.14	0.46	0.19	-0.03	-0.19 *	0.03	-0.21 **	-0.08	-0.04
GFC-dummy	0.04 ***	0.03 *	0.01	-0.00	0.01	0.01	0.03 **	0.02 **	0.03 ***	0.01
COVID-dummy	-0.02	-0.02	-0.05	-0.00	0.01	0.00	0.03 *	-0.01	0.03 **	-0.03
Output gap	0.15 ***	0.02	-0.24	-0.01	0.04	0.07	0.06	0.08 **	0.10 *	0.01
Error correction term	-0.44 ***	-0.37 **	-0.79 ***	-0.96 ***	-0.58 ***	-0.54 ***	-0.52 ***	-0.73 ***	-0.82 ***	-0.49 ***
Adjusted R-squared	0.62	0.85	0.39	0.73	0.86	0.61	0.89	0.80	0.81	0.86
Durbin Watson	1.59	1.45	1.64	1.79	2.03	1.49	1.51	1.49	1.69	1.67
Total number of observations	72	58	60	73	72	72	59	72	69	72
Total number of explanatory variables	13	13	13	13	13	13	13	13	13	13
Memo item										
p-value likelihood ratio test	0.02**	0.03**	0.23	0.00***	0.00***	0.07*	0.49	0.00***	0.02**	0.06*
One effective NEER	-0.36 ***	-0.64 ***	-0.24	-0.09 **	-0.26 ***	-0.01	-0.21 **	-0.19	-0.13 *	-0.09
One effective production cost (in foreign currency)	0.15	0.70 ***	0.83	0.64 ***	0.45 ***	0.71 ***	0.46 ***	-0.21 *	0.17 **	0.55 ***

Testing for the degree of multicollinearity ([10]) between the explanatory variables in tables C and D summarises the variance inflation factors (VIFs) ([11]) of the regressors in Table C, showing the minimum, maximum and median value of the VIF for each Member State. With all VIFs (except Malta) lower than 4, it can be inferred with some confidence that multicollinearity did not inflate the variance of the point estimates.

Table D - Variance inflation factors

	EA	BE	DE	EE	IE	EL	ES	FR	IT	CY	LV	LT	LU	MT	NL	AT	PT	SI	SK	FI
Minimum	1,10	1,07	1,13	1,05	1,07	1,14	1,11	1,07	1,12	1,14	1,13	1,13	1,08	1,09	1,11	1,08	1,10	1,17	1,18	1,09
Median	1,69	1,63	1,69	1,62	1,70	1,63	1,69	1,62	1,66	1,43	1,64	1,96	1,74	1,67	1,69	1,57	1,67	1,64	1,62	1,65
Maximum	3,39	3,36	3,07	3,01	2,79	3,77	3,24	2,99	3,30	2,89	2,63	3,91	3,76	4,04	3,69	3,24	3,26	3,01	2,95	2,98

Note: VIF = 1 / (1-R^2_j) with R^2_j obtained by regressing the j^{th} explanatory variable on the remaining explanatory variables.

Table E shows the correlation for the estimates of the exchange rate elasticity ([12]) in tables B (long term) and C (short term) respectively, with the corresponding sample average of the share of total imports from outside the euro area. The strongest correlation is found for the US dollar ([13]), with a somewhat weaker correlation found for the basket of currencies from the rest of the world. A strong negative correlation may suggest that there are no great differences in the exchange rate pass-through for that specific currency across countries ([14]). A weak correlation with the wrong sign is found for the basket of currencies of non-euro EU Member States. This may be due to global value chain trade with euro invoicing in these countries ([15]).

Table E: Correlation between point estimate and import weight

	Non-EA EU	US	ROW
Long term	0,05	-0,40	-0,28
Short term	0,13	-0,41	-0,10

([10]) Multicollinearity increases the variance of point estimates; but does not make them biased.
([11]) For more details on this diagnostic statistic see https://online.stat.psu.edu/stat462/node/180/
([12]) The point estimates in Box III.1 and Graph III.2 measure the impact of a change in a particular exchange rate on import prices. Implicitly they cover both the magnitude of the pass-through and the import weight of the currency in question.
([13]) Remember that the exchange rate measures the number of foreign currency units per euro, so that a decrease (a depreciation of the euro) may cause a rise in import prices.
([14]) These cross-country differences have been tested more formally in Table E.
([15]) The correlation between the point estimates for and the import weight of the various currencies in a country are not shown as only three observations are available for each country, - compared to 19 observations for the cross-country correlations. Nevertheless, the likelihood ratio tests of the equality of the point estimates for the various currencies in a country are shown in Table C

(Continued on the next page)

Box (continued)

Testing for country differences in exchange rate elasticities

To test whether there are significant differences between the point estimates for the exchange rate elasticities β_{1i} across countries, a modified version of equation (2) is estimated by pooling the data for two countries and estimating the following equation for this pool ([16])

$$(3)\quad \Delta ln(PM_{kt}) = \beta_{k0} + \sum_{z=1}^{2}\sum_{i=1}^{3}\beta_{k1i}\ DUM_{zk}\ \Delta ln(ER_{ki\,t}) + \sum_{z=1}^{2}\sum_{i=1}^{3}\beta_{k2i}\ DUM_{zk}\ \Delta ln(PC_{ki\,t}) + \sum_{z=1}^{2}\beta_{k3i}\ DUM_{zk}\Delta ln\left(\frac{P\_OIL_{kt}}{ER_{kUS\ t}}\right) + \sum_{z=1}^{2}\sum_{k=1}^{n}\beta_{k4l}\ DUM_{zk}\ \Delta X_k + \sum_{z=1}^{2}\beta_{k5}\ DUM_{zk}\ ECT_{t-1} + w_{kt}$$

with the index k indicating the country. For the dummy it holds that $DUM_{zk} = 1$ if z=k and $DUM_{zk} = 0$ if $z \neq k$. To test the null hypothesis that the point estimates are the same for two countries (k=1,2), the second right-hand side term in equation (3) is replaced with $\sum_{i=1}^{3}\beta_{1i}\ \Delta ln(ER_{ki\,t})$, i.e. no differences in responsiveness from $\beta_{11i} = \beta_{21i}$. On retrieving the log likelihood of both estimated equations ([17]), Table F shows the p-values at which the null hypothesis (i.e. the same exchange rate elasticity between two Member States) can be rejected applying a likelihood ratio test. These results suggest that the null-hypothesis of the equality of long- and short-term elasticities can be rejected for most country combinations at a fairly high confidence level.

Table F: Same total exchange rate elasticity between two Member States (p-values)

	Long-term relationship																			
	EA	BE	DE	EE	IE	EL	ES	FR	IT	CY	LV	LT	LU	MT	NL	AT	PT	SI	SK	FI
EA	-																			
BE	0.04**	-																		
DE	0.00***	0,13	-																	
EE	0.00***	0,58	0.00***	-																
IE	0.00***	0,33	0.00***	0,91	-															
EL	0.00***	0.01***	0.00***	0.04**	0.01***	-														
ES	0.01***	0.08*	0.00***	0.03**	0.00***	0,27	-													
FR	0,62	0.10*	0.01***	0.00***	0.01***	0.00***	0.01***	-												
IT	0.03**	0,11	0.00***	0.03**	0.01***	0.04**	0,59	0.05*	-											
CY	0.00***	0,11	0.00***	0,33	0.05**	0,43	0,3	0.00***	0,14	-										
LV	0.00***	0.01***	0.00***	0.08*	0.10*	0,89	0,2	0.00***	0.07*	0,46	-									
LT	0.00***	0.00***	0.00***	0.00***	0.00***	0,13	0,24	0.00***	0,19	0,13	0,42	-								
LU	0.00***	0.00***	0.02**	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	-							
MT	0.00***	0.00***	0.04**	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0,12	-						
NL	0.02**	0,64	0.00***	0,7	0,5	0.00***	0.02**	0,13	0,15	0.01**	0.00***	0.00***	0.00***	0.00***	-					
AT	0.01**	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	-				
PT	0.00***	0.00***	0.00***	0.00***	0.00***	0,48	0,17	0.00***	0.01***	0.00***	0.03**	0,11	0.00***	0.00***	0.00***	0.00***	-			
SI	0.00***	0.00***	0.00***	0.00***	0.00***	0,14	0,16	0.00***	0.01***	0.00***	0.00***	0.01**	0.01**	0.02**	0.00***	0.00***	0,26	-		
SK	0.00***	0.00***	0.00***	0.00***	0.08*	0.00***	0.00***	0.00***	0.00***	0.00***	0.02**	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	-	
FI	0.00***	0.01***	0.00***	0.01***	0.00***	0,15	0,24	0.00***	0.01**	0.06*	0.04**	0.01**	0.00***	0.00***	0.00***	0.00***	0,27	0,74	0.00***	-

	Short-term relationship																			
	EA	BE	DE	EE	IE	EL	ES	FR	IT	CY	LV	LT	LU	MT	NL	AT	PT	SI	SK	FI
EA	-																			
BE	0,29	-																		
DE	0.09*	0,69	-																	
EE	0.10*	0,3	0,46	-																
IE	0,13	0,36	0,88	0,65	-															
EL	0.00***	0.02**	0.08*	0.03**	0,13	-														
ES	0.09*	0,37	0,93	0,44	0,94	0,28	-													
FR	0,39	0.02**	0.00***	0.02**	0.02**	0.00***	0.01**	-												
IT	0.09*	0.03**	0.04**	0,19	0,21	0.01***	0,11	0,23	-											
CY	0.02**	0.08*	0,28	0.02**	0,24	0,67	0,64	0.00***	0.02**	-										
LV	0,11	0,2	0,64	0,52	0,87	0,16	0,67	0.02**	0,18	0,15	-									
LT	0,16	0.02**	0.01**	0.04**	0.04**	0.00***	0.03**	0,65	0,56	0.01**	0.02**	-								
LU	0,47	0,26	0,27	0.06*	0,25	0.10*	0,28	0,69	0,52	0,15	0,12	0,94	-							
MT	0,32	0,63	0,95	0,66	0,89	0.03**	0,84	0.05*	0,32	0,23	0,34	0.04**	0,1	-						
NL	0,34	0,21	0,14	0,62	0,29	0.00***	0,15	0,21	0,4	0.01**	0,23	0,18	0,42	0,61	-					
AT	0.08*	0,71	0,91	0,4	0,77	0,21	0,96	0.00***	0.01**	0,52	0,61	0.00***	0,16	0,67	0.06*	-				
PT	0.00***	0.00***	0.04**	0.04**	0,37	0.09*	0,15	0.00***	0.03**	0.07*	0,66	0.01***	0,24	0.05*	0.00***	0.06*	-			
SI	0.05**	0,29	0,84	0,64	0,96	0.10*	0,91	0.00***	0.06*	0,18	0,73	0.01**	0,23	0,86	0,17	0,9	0.07*	-		
SK	0.07*	0,12	0,42	0,28	0,75	0.08*	0,68	0.02**	0,37	0,35	0,38	0.06*	0,3	0,82	0,22	0,25	0,11	0,38	-	
FI	0.02**	0.08*	0,16	0.03**	0,21	0,18	0,4	0.01***	0,11	0,71	0,12	0.05*	0,35	0,3	0.02**	0,28	0.07*	0.09*	0,47	-

1) Lower part of symmetric matrix shown.

(2) Null hypothesis: β_11i = β_21i for i=NEA, US, ROW in equation (3) of Box III.1.

Likelihood ratio test. p-values: * for p<0.10, ** for p<0.05 and *** for p<0.01

([16]) A similar method holds for testing the cross-country equality of elasticities in equation (1).

([17]) I.e. the original equation (3) and the equation with the restriction $\sum_{i=1}^{3}\beta_{1i}\ \Delta ln(ER_{ki\,t})$.

IV. Croatia joining the euro area

By Arian Perić and Adriana Reut

***Abstract**: Euro-area accession is an open, rule-based process. It requires the fulfilment of four economic convergence criteria - sometimes referred to as the Maastricht criteria - on price stability, sustainable public finances, exchange rate stability and nominal long-term interest rate convergence. A country's national legislation on monetary affairs must also be brought into line with the Treaty on the Functioning of the European Union. The latest assessment of progress made by the non-euro Member States on converging towards adopting the euro was published in the Commission's 2022 Convergence Report on 1 June 2022. This assessment found that Croatia fulfilled all the convergence criteria, paving the way for the Council decision of 12 July 2022 that Croatia becomes the 20th member of the euro area as of 1 January 2023. This section presents the key economic considerations underpinning this positive assessment, emphasising the sustainability of convergence. It also examines a few methodological issues specific to the 2022 assessment.*

IV.1. Introduction

Member States adopting the euro are required to show achievement of a high level of sustainable economic convergence. Article 140(1) of the Treaty on the Functioning of the European Union (TFEU) stipulates that such convergence be assessed with reference to the fulfilment of four economic convergence criteria: price stability, sustainable public finances, exchange rate stability and nominal long-term interest rate convergence. The achievement of convergence (the fulfilment of the criteria) must also be sustainable, meaning that it must be durable, not based on temporary factors. Finally, a country's national legislation on monetary affairs must be brought into line with the requirements of the Treaty.

The Commission's latest assessment of convergence, covering all the non-euro area Member States except Denmark ([142]), was published in its Convergence Report on 1 June 2022 ([143]). The report concluded that, based on data available up to April 2022, only Croatia fulfilled the convergence criteria set out in the TFEU. The report therefore concluded that Croatia was ready to adopt the euro on 1 January 2023. This section presents the key considerations underlying that assessment, including the main methodological issues. Subsection IV.2 sets out the TFEU's criteria for assessing convergence. Subsection IV.3 focuses on Croatia's convergence with the euro area, including the underlying macroeconomic analysis on the sustainability of convergence. Subsection IV.4 reviews several methodological issues specific to the 2022 assessment. Subsection IV.5 concludes with what must be done next for Croatia's to become the 20th member of the euro area.

IV.2. Assessment of convergence criteria

In its 2022 Convergence Report, the Commission's convergence assessment was based on the following nominal convergence criteria, in line with Article 140(1) ([144]) of the TFEU.

- Price stability, as shown by average inflation in the period of 1 year before the assessment not exceeding by more than 1.5% average inflation of, at most, the three best-performing Member States in terms of price stability. The inflation reference value for the purpose of this report was 4.9% in April 2022, based on the inflation rates of France, Finland and Greece, which had the lowest inflation rates after conducting an outlier analysis to identify countries whose inflation rates cannot be seen as meaningful for the selection of the three best-performing Member States in terms of price stability (Box IV.2 for more details).

- Sound and sustainable public finances as shown by the absence of a Council Decision on the existence of an excessive government deficit as determined in accordance with Article 126(6) of the TFEU.

([142]) Denmark, having negotiated an opt-out arrangement before the adoption of the Maastricht Treaty, does not participate in the third stage of Economic and Monetary Union.

([143]) https://economy-finance.ec.europa.eu/publications/convergence-report-2022_en. The Commission's assessment was complemented by the European Central Bank's (ECB's) own Convergence Report: https://www.ecb.europa.eu/pub/convergence/html/index.en.html

([144]) The cut-off date for the data was 18 May 2022 so that the last monthly data cover April 2022.

- Exchange rate stability as shown by participation in the Exchange Rate Mechanism (ERM II) without severe tensions and without devaluation for a period of 2 years before the assessment. The two-year period for assessing exchange rate stability in this report was 19 May 2020 to 18 May 2022.

- Long-term interest rate convergence as shown by average nominal long-term interest rates over the preceding year not exceeding that of the three best EU performers in terms of price stability by more than 2%. The reference value for this criterion was 2.6% in April 2022.

- In addition to the above nominal convergence criteria, legal compliance in monetary field with the TFEU and the Statute of the European System of Central Banks/the ECB was also assessed as part of the convergence assessment ([145]). The TFEU also requires an assessment of other factors relevant for economic integration and convergence, to complement the assessment of the nominal convergence criteria. These additional factors include the integration of markets, the development of the balance of payments, the business environment, and the quality of the institutional framework. The assessment of additional factors is seen as an important indication of whether the integration of a Member State into the euro area would proceed smoothly and sustainably.

- As stipulated in the TFEU, the progress made on convergence (the fulfilment of the criteria) must be sustainable, meaning it must be durable, not based on temporary factors. In the case of inflation, sustainability means that satisfactory inflation performance must be due to the adequate behaviour of input costs and other factors structurally influencing price developments, rather than to cyclical or temporary factors. The convergence assessment therefore takes into account the role of the macroeconomic situation and the cyclical position of the economy in the inflation performance, developments in unit labour costs, and developments in import prices, to assess how external price developments have affected domestic inflation. The impact of administered prices and indirect taxes on headline inflation is also considered.

- As summarised in Table 1, Croatia was the only Member State that fulfilled all the convergence criteria.

Table IV.1: **Conclusions of the 2022 Convergence Report**

Member State	Legal compatibility (art. 131 TFEU)	Price stability Reference: 4.9% EA average: 4.4%	Public finances	Exchange rate	Long-term interest rate Reference: 2.6% EA average: 0.3%
Bulgaria	Not fully	No (5.9%)	Yes (No EDP)	Yes (ERM II)	Yes (0.5%)
Czechia	Not fully	No (6.2%)	Yes (No EDP)	No	Yes (2.5%)
Croatia	Fully	Yes (4.7%)	Yes (No EDP)	Yes (ERM II)	Yes (0.8%)
Hungary	Not fully	No (6.8%)	Yes (No EDP)	No	No (4.1%)
Poland	Not fully	No (7.0%)	Yes (No EDP)	No	No (3.0%)
Romania	Not fully	No (6.4%)	No (EDP)	No	No (4.7%)
Sweden	Not fully	Yes (3.7%)	Yes (No EDP)	No	Yes (0.4%)

Source: Commission's Convergence Report 2022.

IV.3. Croatia's sustainable convergence with the euro area

The Commission's assessment concludes that Croatia has fulfilled the four nominal convergence criteria and its legislation is fully compatible with the TFEU. This paved the way for the Council decision of 12 July 2022 that Croatia becomes the 20th member of the euro area.

Price stability

Average inflation (Harmonised Index of Consumer Prices (HICP)) during the 12 months preceding the end of April 2022 was 4.7%, slightly below the reference value of 4.9%. The reference value was calculated as the average of the twelve-month average inflation rates in France, Finland, and Greece, plus 1.5 percentage points (Box IV.2). Croatia's twelve-month average inflation rate in December 2022 and December 2023 was forecast at 6.1% and 2.8%, respectively. These results were closely aligned with those of the euro area (6.1% and 2.7% respectively) and below the projected reference values (6.3% and 3.4%).

Taking a longer perspective, inflation in Croatia has been broadly in line with that of the euro area since the country joined the EU (Graph IV.1). Croatia experienced a short period of relatively high inflation in the year before joining the EU, driven by sluggish productivity growth and changes in taxation. However, by the time it joined the EU in July 2013, inflation had come down significantly. Since the second half of 2013, both headline and

([145]) Legal compliance is assessed in terms of the central bank independence, the prohibition of monetary financing and privileged access, and the Member State's integration into the European System of Central Banks.

core inflation have been very close to the euro area average, with annual deviations never exceeding one percentage point. This reflects several interrelated factors, including Croatia's exchange rate regime (see below), high and increasing trade and financial integration, and a business cycle relatively synchronised with the euro area. As a result, Croatia has been found to have fulfilled the price stability criterion in every convergence report since it joined the EU.

However, given the currently high uncertainty surrounding the inflation outlook, Croatia's successful integration into the euro area will require the continued monitoring of several upside inflation risks. Long-term inflation prospects will depend in particular on wages growing in line with productivity. Investments and reforms related to the implementation of the Recovery and Resilience Facility (RRF) could also be important drivers of future price developments. On the one hand, recovery and resilience plan (RRP) investments will boost aggregate demand in the economy. This could put upside pressures on prices in the short term. On the other hand, many reforms (reduction of the administrative burden and para-fiscal charges, the deregulation of services etc.) should enhance market competition and reduce costs for companies, exerting downward pressures on the prices of final products in the long term.

Graph IV.1: **HICP Inflation**

Source: Eurostat.

Sound and sustainable public finances

Croatia was not subject to a Council decision on the existence of an excessive government deficit. This was the case for all Member States except Romania ([146]), reflecting the position taken by the Commission for the past 2 years not to propose to open excessive deficit procedures, given the extraordinary uncertainty created by the COVID-19 crisis and its aftermath. In any case, Croatia's deficit was below 3% of GDP in 2021.

A country joining a monetary union makes it even more important to have adequate fiscal capacity and fiscal buffers to complement the common monetary policy and address the asymmetric effects of shocks. In most of the years before the pandemic, Croatia's fiscal stance was contractionary ([147]) (Graph IV.2), with a considerable improvement in the structural budget balance during a period of robust growth. As a result, it significantly improved its fiscal position, from a government deficit of almost 8.0% of GDP in 2011 to a period of surpluses and balanced budgets in 2017-2019. This created the fiscal space needed to react, without endangering mid-term fiscal sustainability, to the particularly severe crisis triggered by the COVID-19 shock and to the impact of the current uncertainties related to rising energy and commodity prices. In 2020, in reaction to the COVID-19 shock, the fiscal stance was very much expansionary and counter-cyclical. In 2021, the government support measures were gradually phased out as the economy recovered, with both effects helping to shrink the headline deficit to 2.9% of GDP. According to the Commission's Spring 2022 Economic Forecast, the government deficit was expected to decline further in 2022 and 2023 to 2.3% and 1.8% of GDP respectively. New fiscal measures have been introduced since the Spring Economic Forecast to cushion the socioeconomic effects of rising energy and commodity prices.

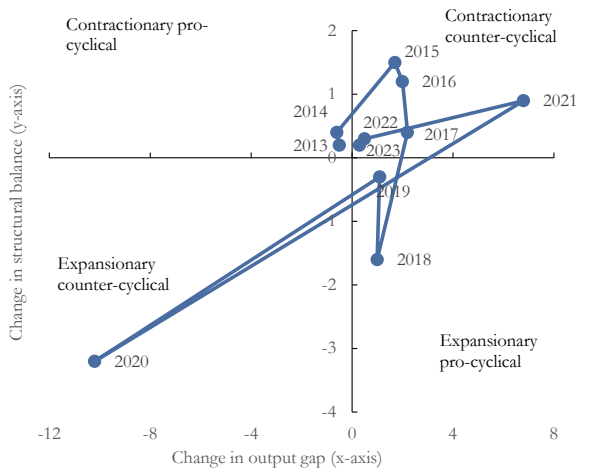
After decreasing significantly in the years before the COVID-19 crisis, Croatia's public debt spiked in 2020. However, in 2021, the debt ratio decreased by 7.5 percentage points, to just under 80% of GDP, resuming the positive pre-crisis trend. The positive trend was forecast to continue according

([146]) Romania is subject to an EDP because its high deficit before the COVID-19 crisis.

([147]) The fiscal stance is measured as the change in primary expenditure (net of discretionary revenue measures), excluding Covid-19 related temporary emergency measures but including expenditure financed by non- repayable support (grants) from the RRF and other EU funds, relative to medium- term potential growth. A negative (positive) sign of the indicator corresponds to an excess (shortfall) of primary expenditure growth compared to medium-term economic growth, indicating an expansionary (contractionary) fiscal policy.

to the Commission's Spring 2022 Economic Forecast both in 2022 and 2023 thanks to relatively strong nominal GDP growth and a further narrowing of the deficit. The Commission's fiscal sustainability analysis classifies Croatia as having low fiscal short-term sustainability risks in the short and medium fiscal sustainability risks in the medium and long terms ([148]). Further strengthening of the sustainability of Croatia's public finances hinges on increasing the economy's growth potential, while continuing to follow fiscal rules.

Graph IV.2: **Evolution of the fiscal stance in Croatia, 2012-2021**



Source: Commission estimates.

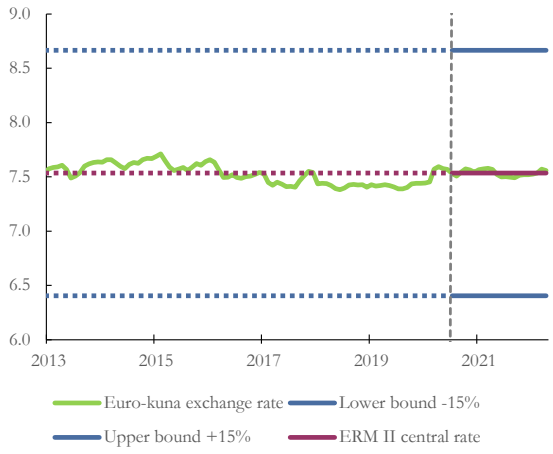
Exchange rate stability

The euro-kuna exchange rate remained very close to the ERM II central rate for the 2 years covered by the assessment, without any signs of tensions. During this period, the kuna was never traded more than around 2% below or above a level equivalent to the central ERM II rate adopted in July 2020.

In fact, the kuna exchange rate has been remarkable stable for over a decade, even during periods of stress such as the global financial crisis and the COVID-19 crisis (Graph IV.3). The long track record of exchange rate stability is the result of Croatia's successive exchange regimes. Until the inclusion of the kuna in ERM II in July 2022, the Croatian National Bank operated a managed floating exchange rate regime, using the exchange rate against the euro as the main nominal anchor to achieve its primary objective of price stability. Since its inclusion in ERM II, the kuna's volatility has further decreased, as the kuna has fluctuated in a narrow band of less than +/-1% of its central rate against the euro. In the last 2 years, the kuna's exchange rate against the euro has continued to exhibit a seasonal pattern of mild temporary appreciation in the summer, a consequence of foreign currency inflows related to the tourism sector. It usually went below the central rate against the euro in the summer and moved just above it in the remaining months.

Since joining ERM II, exchange rate stability has also been supported by a set of structural reforms. Under the new reinforced approach to ERM II participation (Box IV.1), before joining the mechanism, Croatia had implemented a number of policy commitments considered critical for its successful entry into and operation in ERM II. Since joining ERM II, national authorities have also committed themselves to implementing a set of additional policy measures, the so-called ERM II post-entry commitments, to ensure the country's smooth functioning in the euro area.

Graph IV.3: **Euro-kuna exchange rate**



Source: European Central Bank.

Long-term interest rate convergence

Croatia fulfilled long-term interest rate criterion by a large margin. In April 2022, the reference value, calculated as the average of long-term interest rates in France, Finland and Greece, plus 2 percentage points, was 2.6%. In that month, the twelve-month moving average of the yield on the Croatian

([148]) Annex 20 (Debt Sustainability Analysis) of the 2022 Country Report - Croatia: https://ec.europa.eu/info/system/files/2022-european-semester-country-report-croatia_en.pdf.

benchmark bond was 0.8%, 1.8 percentage points below the reference value.

During most of the global financial crisis, Croatia's benchmark long-term interest rate was high, exceeding 6.0% between 2010 and 2012, compared with 4.0% in the euro area. The situation improved gradually as the crisis abated and the economy gained momentum. After Croatia joined the EU in 2013, the benchmark long-term interest rate used in the convergence assessment fell steadily from 4.0% in 2014 to 1.3% in 2019 and 0.5% in 2021. The spread with the German bund fell from 340 basis points in 2016 to 150 basis points in 2019 and 80 basis points in 2021, supported by a reduction in the government debt ratio and continued price and exchange rate stability ([149]).

Additional factors

The analysis of additional factors also provided a positive indication of Croatia's ability to integrate into the euro area without difficulties.

First, the high level of trade and financial integration of the Croatian economy into the euro area is one of the main reasons for the high level of synchronisation of business cycles between the two economies (Kotarac, Kunovac and Ravnik, 2017) ([150]). Recently published research (Deskar-Škrbić, Kotarac and Kunovac, 2020 and Deskar-Škrbić and Kunovac, 2020) ([151]) shows that, for the most part, business cycles and inflation in the euro area and Croatia share the same drivers and that symmetric (or common) factors in the euro area determine economic developments in Croatia the most ([152]). The level of synchronisation of business and inflation cycles between the two economies means that the Croatian economy is affected by spillovers from positive or negative demand and supply shocks in the euro area. The role of asymmetric (idiosyncratic) factors for GDP and inflation developments in Croatia has also been steadily decreasing for over a decade, and it is expected that euro adoption will result in the continuation of this trend. All of this suggests that using common monetary policy as a key policy instrument to address shocks that affect the whole euro area should be suitable for the Croatian economy.

Second, as the Commission's 2022 In-Depth Review concludes, Croatia is no longer regarded as experiencing macroeconomic imbalances. In particular, the deleveraging of the economy continued in 2021 on the back of a strong rebound in economic activity, with both public and private debt ratios decreasing and the current account returning to a surplus.

Third, Croatia's banking sector is highly integrated into the EU financial sector, in particular through foreign ownership of the banking sector. Around 90% of the sector's assets are held by subsidiaries of foreign banks. In parallel with the inclusion of the kuna in ERM II, the Croatian National Bank entered into close cooperation with the ECB, effectively joining the Banking Union. On 1 October 2020, in line with the reinforced approach to ERM II participation (Box IV.1), Croatia also joined the Single Resolution Mechanism, and the ECB became responsible for directly supervising Croatia's major banking institutions and for the oversight of less significant institutions.

On the other hand, Croatia performs worse than most euro area Member States in terms of the quality of its business environment, according to several commonly used indicators ([153]), while corruption is an important issue, as reflected in Croatia's poor ranking in the perception of corruption index. These shortcomings weigh on Croatia's long-term potential growth, by hampering investment and weakening employment growth. However, there has been a renewed effort by the Croatian authorities to improve the business environment, in particular to reduce the

([149]) The relationship between the bond market, macroeconomic fundamentals and a set of additional covariates in Croatia between 2011 and 2017 is examined in the following paper: Žaja, M. M., Jakovčević, D., and Višić, L. (2018), 'Bond Yield: Evidence from a Highly Euroised Small Open Economy', *International Journal of Economic Sciences*, Vol. VII(2), pp. 87-106.

([150]) Kotarac, K., Kunovac, D., and Ravnik, R. (2017), 'Coherence of business cycles and economic shocks between Croatia and Euro Area Member States', Croatian National Bank Working Paper, WP 53.

([151]) Deskar-Škrbić, M., Kotarac, K., and Kunovac, D. (2020), 'The third round of euro area enlargement: Are the candidates ready?', Journal of International Money and Finance, 107, 102205. Deskar-Škrbić, Milan, and Davor Kunovac. 'Twentieth anniversary of the euro: why are some countries still not willing to join? Economists' view', Comparative Economic Studies 62.2 (2020): 242-262.

([152]) Empirical literature points out that spillovers of shocks from major markets are stronger in emerging countries with (quasi-) pegged exchange rates, which could be seen as an additional reason why common shocks play the largest part in economic developments in Croatia. See, for example, Corsetti, G, K Kuester, G Mueller, and S Schmidt (2021). The Exchange Rate Insulation Puzzle', CEPR Discussion Paper No. 15689.

([153]) World Bank's Ease of Doing Business Index or the IMD World Competitiveness Index.

administrative burden and regulatory restrictions, and to make the justice and anti-corruption systems more efficient and effective, including in the context of the numerous RRP reforms and supported by the RRF.

IV.4. Methodological issues

The 2022 assessment of the convergence progress of the non-euro area Member States was carried out against the backdrop of extraordinary economic shocks and uncertainty, which gave rise to some methodological issues, namely the capacity of the assessment framework to adequately assess the impact of the COVID-19 pandemic and Russia's military invasion of Ukraine, as well as the need for an outlier analysis underpinning the selection of the three best-performing Member States in terms of price stability.

COVID-19 pandemic

The economic shock triggered by the COVID-19 pandemic and the recovery in 2021 had a significant impact on some of the economic indicators used in the 2022 Convergence Report. This was especially the case for the price stability criterion, as the measures taken in response to the COVID-19 crisis, the robust recovery in 2021 and the related supply bottlenecks and surge in commodity prices had major consequences for Member States' inflation performance. First, the dispersion of inflation rates across the EU increased dramatically in 2021 and 2022, mainly due to the heterogeneous impact of the recovery on inflation rates and differences in energy price inflation across Member States. The diversity of the fiscal and non-fiscal measures taken by national authorities to cushion the impact of higher energy prices also contributed to inflation dispersion. While some of these measures, such as social transfers to the most vulnerable households, did not have a direct impact on consumer prices, others, such as cuts in indirect taxes and wholesale and retail energy price subsidies, did have a direct impact on measured inflation. Long-term interest rates were also initially affected by the policy measures taken to stabilise financial markets and preserve favourable financing conditions and later by higher inflation expectations and the differentiated paths of monetary tightening across non-euro area Member States and relative to the euro area. The fulfilment of the public finances criterion was affected by the European Commission's decision, since spring 2020, not to recommend launching new excessive deficit procedures, taking into account the exceptional uncertainty, including for designing a detailed path for fiscal policy.

Overall, however, the convergence assessment framework proved to be fairly resilient to the effects of the COVID-19 crisis on some indicators, for several reasons:

First, the analysis of compliance with the convergence criteria for inflation or interest rates is relative to the best-performing Member States in terms of price stability, and generally takes into account overall euro area performance. This has minimised the impact on the convergence assessment of the economic shocks triggered by the COVID-19 crisis.

Second, the assessment of the sustainability of convergence also relies on other indicators that are less influenced by these economic shocks, such as different measures of underlying inflation and price pressures, including core inflation (excluding energy and unprocessed food), wages and labour costs, and the contributions to HICP growth from imported inflation and administered prices and taxes.

Third, the sustainability of convergence was assessed by looking at likely economic developments based on the Commission's Spring Economic Forecast. The assessment of sustainability was also supported by an analysis of structural factors – by definition only marginally influenced by temporary shocks such as COVID-19 – including the quality of the business environment, trade links and financial integration. The findings of the Commission's enhanced surveillance process, notably the macroeconomic imbalances procedure, also provided information on developments in macroeconomic vulnerabilities that could hamper convergence.

Box IV.1: A reinforced approach to future ERM II participation

Learning from past episodes of economic overheating in ERM II and from the euro-area crisis, the ERM II parties clarified the modalities for a reinforced approach to future ERM II participation in July 2018, in the statement on Bulgaria's path towards ERM II.

The ERM II parties stated that this approach would apply to all Member States wishing to join ERM II from then onwards. The reinforced approach was confirmed in a statement by the ERM II parties in July 2019 on Croatia's path towards ERM II participation. This approach involves the applicant Member State and ERM II parties agreeing on several policy commitments to be implemented by the former before joining ERM II. This package of policy commitments aims at maximising the country's chances of operating smoothly in ERM II. Moreover, the applicant is expected to enter into an arrangement called 'close cooperation' with the European Central Bank (ECB) for banking supervision, which means joining the Banking Union.

In July 2019, Croatia committed to implementing policy measures in six areas before joining ERM II: i) banking supervision (close cooperation with the ECB), ii) the macroprudential framework, iii) the anti-money laundering framework, iv) statistics, v) public sector governance and vi) business environment. In June 2020, the Croatian authorities notified the ERM II parties that it had fulfilled these commitments, which the Commission and the ERM II parties welcomed.

At the time of its ERM II entry in July 2020, Croatia committed to implementing an additional set of policy measures (ERM II post-entry commitments). The aim was to achieve a high degree of sustainable economic convergence before adopting the euro and to strengthen its capacity so it can prosper in the euro area. Building on the progress with the prior-entry commitments, the post-entry commitments covered four areas: i) anti-money laundering, ii) business environment, iii) state-owned enterprises and iv) insolvency framework.

In spring 2022, Croatia reported to the Eurogroup Working Group and the Eurogroup on its full implementation of all four of its post-entry ERM II commitments. All of these commitments are also reflected in Croatia's recovery and resilience plan, which follows up with additional measures in all four areas.

The assessment in the 2022 Convergence Report also took into consideration for the first time the implementation of the ERM II post-entry commitments.

Russia's military aggression against Ukraine

As far as Russia's invasion of Ukraine is concerned, the cut-off date of the 2022 Convergence Report (18 May 2022) and the TFEU-defined methods for calculating the price stability and long-term interest rate criteria based on (backward-looking) one-year averages imply that the corresponding data used for the assessment largely reflect the situation before Russia's invasion.

Identifying the best performers in terms of price stability

The notion of best performers is, however, not defined explicitly in the TFEU. It has traditionally been interpreted in terms of the lowest inflation rates in the EU, consistent with the asymmetric application of the 1.5 percentage point margin. The long-established position of the European Commission in past convergence report analyses is that the identification of the three best inflation performers should not be mechanical. It should be based on economic judgement. In particular, an outlier analysis should be done to identify countries whose inflation rates cannot be seen as meaningful benchmarks for other countries. This has resulted in the exclusion of outliers from the list of best performers in several cases in the past, notably in the Convergence Reports of 2004, 2010, 2013, 2014 and 2016. In the 2022 Convergence Report, Malta and Portugal were identified as outliers, leading to the selection of France, Finland and Greece as the three best inflation performers. Box IV.2 explains the methodological framework for identifying outliers and the reasons for excluding Malta and Portugal from the list of best performers.

IV.5. Conclusion

Membership of the euro area should be conducive to higher investment and consumption through lower financing and transaction costs, as well as higher inflows of capital. Removing of a large share of the remaining foreign exchange risks from the banking system, the liquidity and financial support possibilities in the euro area, and Croatia's integration into the banking union also further increase the economic credibility and stability. However, these benefits are not assured if the economy is not well prepared for the new currency. Implementing sound economic policies that increase potential growth and the adjustment capacity and strengthen the institutional framework is therefore crucial for successful membership of the euro area. In this respect, the implementation of the reforms and investments that are part of Croatia's RRP under the RRF will help further strengthen its economy, while the stability it will gain from joining the single currency will be especially valuable in times of crisis and uncertainty.

The assessment of convergence in 2022 was carried out during a period of significant economic upheaval, complicating the assessment of convergence. Looking ahead, while the convergence assessment framework has proved to be fairly resilient to the effects of the COVID-19 crisis, it should be acknowledged that shocks like Russia's military aggression of Ukraine and the weaponisation of energy supply may prove to be more challenging for the framework in the future. This is particularly the case for the assessment of inflation convergence. Very large supply shocks, such as the current one, tend to lead to significant divergences in inflation rates across the Member States. These asymmetric effects are in part due to differences in the structural features of national economies (the structure of the energy supply mix) and are therefore beyond the control of national authorities, in the short term at least.

Box IV.2: Outlier analysis underpinning the selection of the three best performers in terms of inflation

In the 2022 Convergence Report, France, Finland and Greece were identified as the 3 'best-performing Member States' for calculating the reference value for the price stability criterion and, ,as a result, also the reference value for the long-term interest rate criterion. This outcome reflected the application of an 'outlier analysis' as in previous convergence reports.

As in the past, outliers in terms of inflation have been identified based ontwo criteria taken in combination: i) an inflation rate substantially below the euro area average and ii) an inflation rate driven by country-specific factors that cannot be seen as representative of the process driving inflation in the euro area.

On this basis, Malta and Portugal were identified as outliers in the 2022 Convergence Report.

In past convergence reports, Member States that had an inflation rate 1.5 percentage points or more below the euro area were generally considered as outliers. Similarly, in April 2022, the 12-month average inflation rates of Malta and Portugal were respectively 2.2 percentage points and 1.7 percentage points below the euro area average of 4.4%.

Country-specific factors were also at play:

- In the case of Malta, the change in the Harmonised Index of Consumer Prices (HICP) weights system in 2021 exerted strong downward pressure on the country's headline HICP inflation (as opposed to an upward contribution on the euro area average). This was mainly due to a reduction in the weights of several services sectors that are important for the Maltese economy. Furthermore, energy prices remained stable despite the surge in international energy prices, largely reflecting sizeable financial support measures that were introduced as of late 2021 and targeted the energy sector. As a result, the 12-month average inflation rate for energy between May 2021 and April 2022 was -0.4% in Malta, compared to 24.7% for the euro area.
- In the case of Portugal, energy inflation in the 12-month period to April 2022 was limited, and the cyclical position of the country in 2021 was significantly weaker than that of most other EU Member States. A combination of factors weighed on energy inflation, including a broad range of regulatory measures that kept the growth in retail electricity and natural gas prices well below the EU average. Between May 2021 and April 2022, the average 12-month energy inflation rate in Portugal was 13.7%, compared with 24.7% for the euro area. In addition, the country's activity was more severely hit than in most other EU Member States in the early stages of the COVID-19 pandemic, and its recovery in 2021 was slower. In the fourth quarter of 2021, Portugal's GDP was still significantly below its pre-crisis peak, and the gap was the second largest in the EU. This mainly reflected Portugal's large exposure to tourism and particularly aviation-based tourism, which was heavily hit by the pandemic. The relative weakness in Portugal's recovery had a lasting dampening effect on inflation in services, particularly in sectors related to tourism.

Including Malta and Portugal in the list of best performers Member States would not have been appropriate from an economic perspective and have been unfair in terms of equal treatment of Member States. First, including them in the group of three best performers would have led to a very low reference value compared with the euro area average. It would have required that the Member States with a derogation – including Croatia – achieve a better inflation performance than what the euro area was able to deliver on average ([1]). In all past convergence reports, the reference value for inflation was always above the inflation rate for the euro area. Second, the outlier analysis approach in the 2022 Convergence Report is similar to that followed in past

([1]) Member States that have not fulfilled yet the necessary conditions for the adoption of the euro are referred to as Member States with a derogation.

(Continued on the next page)

Box (continued)

convergence reports. This ensures consistency and equal of treatment across time. In particular, as already noted, outliers were identified in the convergence reports of 2004, 2010, 2013, 2014 and 2016.

Annex. The euro area chronicle

The Commission, the Economic and Financial Affairs Council and the Eurogroup regularly take decisions that affect how the Economic and Monetary Union (EMU) works. To keep track of the most relevant decisions, the QREA documents major legal and institutional developments, presented in chronological order with references. This issue covers developments between mid-June 2022 and the end of September 2022. Over the summer, further Recovery and Resilience Facility (RRF) funds were disbursed and the European Central Bank (ECB) announced an additional monetary policy tool, the Transmission Protection Instrument ([190]).

Recovery fund disbursement to Slovakia, Spain and Latvia. In the third quarter of 2022, the Commission continued to transfer funds under the RRF. On 29 April 2022, Slovakia submitted to the Commission its first payment request under its recovery and resilience plan based on the achievement of the 14 milestones of the first instalment of non-repayable support. Key milestones indicated progress in the reforms on the green transition, effectiveness of the judicial system, research and education, but also the fiscal framework, anti-corruption legislation, digitalisation of the public sector, as well as Slovakia's audit and control system for the implementation of the RRF. On 27 June 2022, the Commission adopted a positive preliminary assessment of Slovakia's request ([191]). Following a discussion between Member States, including in the Economic and Financial Committee, the Commission transferred EUR 398.7 million to Slovakia. A similar process was followed after Spain submitted its second request on 30 April 2022. Based on progress in addressing pension adequacy and the duality of the labour market, EUR 12 billion was paid to Spain ([192]). On 17 June 2022, Latvia submitted its first payment request. The Commission issued a positive assessment on 29 July 2022 ([193]). The nine milestones achieved by Latvia covered reforms and investments in the minimum income support system, the development of a high-capacity broadband network, improving the competition environment, reducing corruption risks in public procurement, strengthening remote learning networks and institutions, the prevention of money laundering as well as social housing. As a result, EUR 201 million was disbursed to Latvia.

Approval of the Netherlands' recovery and resilience plan. On 8 September 2022, the Commission approved the Dutch recovery plan (subsequently adopted by the Ecofin Council in October), paving the way for the EU to disburse EUR 4.7 billion in grants to the Netherlands under the RRF ([194]). 48% of the resources under the plan are expected to contribute to the decarbonisation and energy transition. 26% of the plan's allocation will support the digital transition, including investments in quantum technology, artificial intelligence, digital education, and digital government. The plan also put forward a package of targeted reforms to tackle shortcomings in the pension system and strengthen the labour market.

Fiscal policy orientations for 2023. On 11 July 2022, the Eurogroup adopted a statement on fiscal policy orientations for 2023 ([195]). Given the deteriorating macro-economic environment, including weakening growth prospects and strong inflationary dynamics, the Eurogroup considers that using fiscal policies to support overall demand in 2023 is not warranted. Broad-based fiscal measures, such as general reductions in taxes and excise duties, were aimed at mitigating the impact of rapidly rising energy prices at the national level. However, they should be temporary and be gradually adjusted to target the most vulnerable part of the population. Also, policy adjustments should maintain incentives for the energy transition. In this respect, income measures are, in principle, preferable to price measures. However, the negative effect of high energy prices on incomes could not be addressed in the long run through compensatory fiscal measures, and will require investments in energy efficiency and the development of environmentally sustainable local sources of energy over the medium term.

([190]) Annex compiled by Jakub Wtorek. The cut-off date for this annex is 30 September 2022.
([191]) https://ec.europa.eu/commission/presscorner/detail/en/ip_22_3971.
([192]) https://ec.europa.eu/commission/presscorner/detail/en/ip_22_4088.
([193]) https://ec.europa.eu/commission/presscorner/detail/es/ip_22_4625.
([194]) https://ec.europa.eu/commission/presscorner/detail/en/ip_22_5397.
([195]) https://www.consilium.europa.eu/en/press/press-releases/2022/07/11/eurogroup-statement-on-fiscal-policy-orientations-for-2023/.

On 21 July 2022, the ECB announced an additional monetary policy tool, the Transmission Protection Instrument (TPI) ([196]). The TPI complements the flexible reinvestment policy of the pandemic emergency purchase programme, with both instruments aiming to tackle unwarranted, disorderly market dynamics that pose a serious threat to the monetary policy transmission mechanism across the euro area. The Governing Council of the ECB will decide on TPI eligibility based on a cumulative list of criteria assessing in particular (i) compliance with the EU fiscal framework, (ii) absence of severe macroeconomic imbalances, (iii) fiscal sustainability, and (iv) sound and sustainable macroeconomic policies.

([196]) https://www.ecb.europa.eu/press/pr/date/2022/html/ecb.pr220721~973e6e7273.en.html.

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